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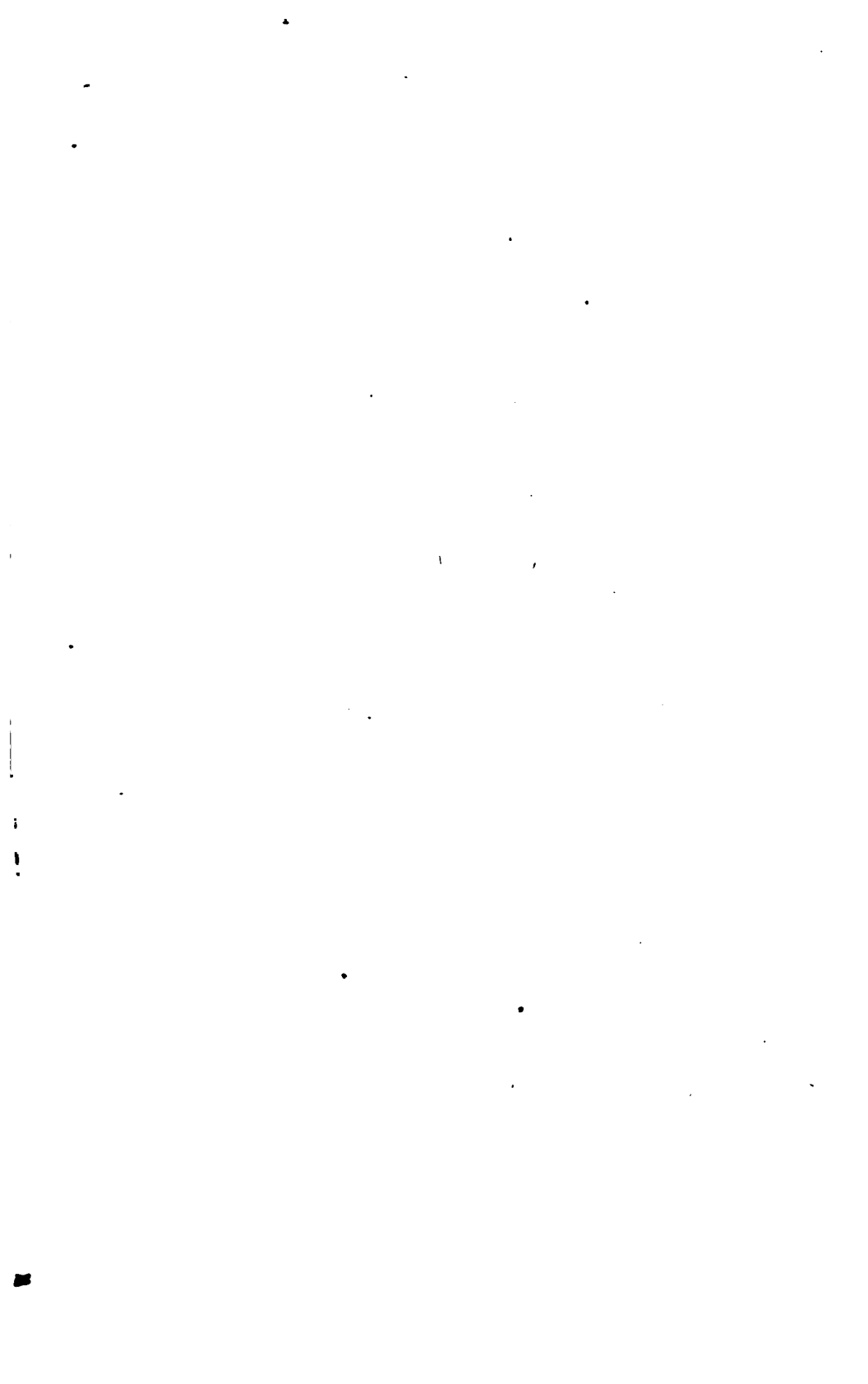
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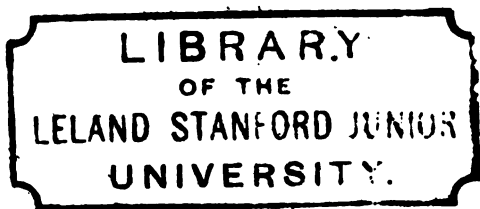


REPORT
OF THE
SECRETARY OF WAR;
BEING PART OF
THE MESSAGE AND DOCUMENTS
COMMUNICATED TO THE
TWO HOUSES OF CONGRESS
AT THE
BEGINNING OF THE FIRST SESSION OF THE FIFTY-FIRST CONGRESS.

IN FOUR VOLUMES.

VOLUME II—IN FOUR PARTS
PART 1.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1889.



A. 1125



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 B. M. HARBOD,
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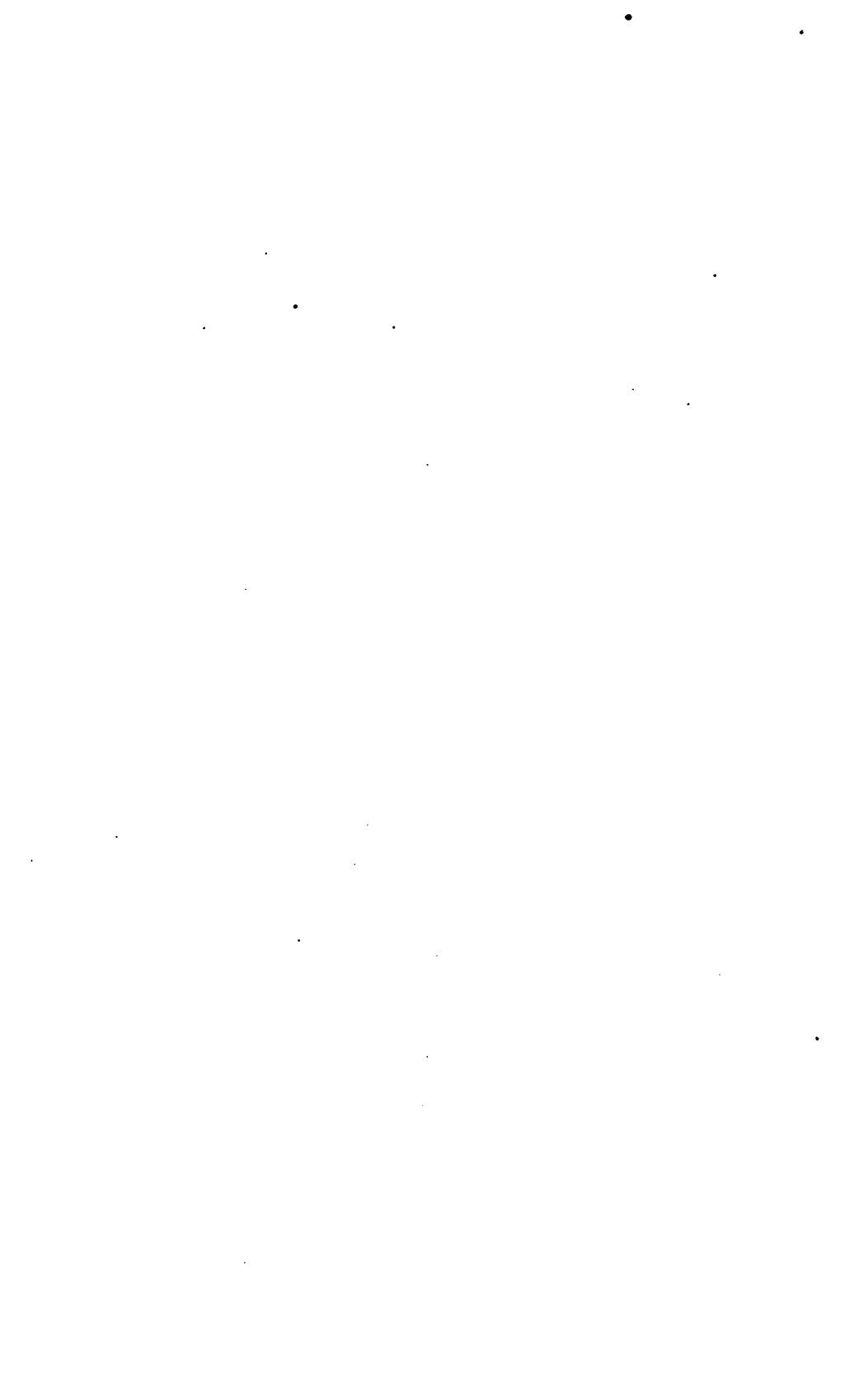
ANNUAL REPORT

OF THE

CHIEF OF ENGINEERS.

UNITED STATES ARMY.

1889.



REPORT

OF

THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., September 30, 1889.

SIR: I have the honor to present for your information the following report upon the duties and operations of the Engineer Department for the fiscal year ending June 30, 1889:

OFFICERS OF THE CORPS OF ENGINEERS.

The number of officers holding commissions in the Corps of Engineers, U. S. Army, at the end of the fiscal year was 109.

Six additional second lieutenants have been added to the Corps by appointment from the Military Academy, to date from June 12, 1889, but they did not become available for duty until after the close of the fiscal year, and are, therefore, not included in the strength of the Corps.

On the 30th of June, 1889, the officers were distributed as follows:

Office Chief of Engineers	3
Office Chief of Engineers, fortifications, and river and harbor works	1
Fortifications and river and harbor works	16
Fortifications, river and harbor works, and division engineer	1
Fortifications, river and harbor works, and Board of Engineers	2
River and harbor works	37
Division engineer and Board of Engineers	1
Division engineer, Board of Engineers, Board of Visitors, and Mississippi River Commission	1
Mississippi River Commission	1
Mississippi River Commission and Missouri River Commission	1
Public buildings and grounds and Washington Aqueduct	1
Washington Aqueduct	1
Post of Willets Point, Engineer School of Application, and Battalion of Engineers	1
Battalion of Engineers and Engineer School of Application	14
Under orders	1
Absent in Europe under orders	4
Leave of absence	1
Sick leave of absence	1
Incapacitated for active service and on indefinite leave of absence	1
Detached, on duty with Light-House Establishment, at Military Academy, with Board of Commissioners of the District of Columbia, with the Missouri River Commission, at U. S. Infantry and Cavalry School, and as Military Attaché	20

The officers detached were on duty as follows :

Col. John G. Parke, Superintendent Military Academy until June 24, 1889	1
Maj. David P. Heap, engineer third light-house district	1
Maj. Charles W. Raymond, Engineer Commissioner of the District of Columbia	1
Maj. William S. Stanton, engineer first and second light-house districts	1
Maj. James F. Gregory, engineer secretary of the Light-House Board	1
Capt. John C. Mallery, engineer fifth and sixth light-house districts	1
Capt. Edward Maguire, engineer fourth light-house district	1
Capt. John G. D. Knight, instructor of engineering at the U. S. Infantry and Cavalry School	1
Capt. Thomas W. Symons and James L. Lusk, assistants to the Engineer Commissioner of the District of Columbia	2
Capt. George McC. Derby and Lieut. John Biddle, on duty with Company E, Battalion of Engineers, and at the Military Academy	2
Lieut. Theodore A. Bingham, secretary and disbursing officer of the Missouri River Commission	1
Lieut. Hiram M. Chittenden, on duty with the Missouri River Commission	1
Lieuts. George W. Goethals, Harry F. Hodges, Eugene J. Spencer, and Irving Hale, on duty at the Military Academy	4
Lieut. John Millis, assistant to engineer third light-house district	1
Lieut. James C. Sanford, Military Attaché to U. S. Legation at Berlin	1

20

SEA-COAST DEFENSES.

The permanent defenses of the country remain in the same inefficient condition that has obtained since the close of the civil war. No appropriation for new construction has been made since that of February 10, 1875. The act of September 22, 1888, appropriated \$100,000 for the protection, preservation, and repair of existing works. This has been expended or pledged for such minor repairs as have appeared most necessary and for the care of the defenses. The act of March 2, 1889, appropriated \$100,000 for the same purpose for the current fiscal year, and this appropriation will be exhausted at its close. These two appropriations have been carefully allotted among the several works according to their needs, and only the repairs most urgently required have been considered. Many of these works are still of value in connection with new works projected, and the estimate submitted is for their protection, preservation, and repair.

Our country, great in population, wealth, and natural resources, prominent among the nations of the earth in intelligence, ingenuity, and energy, and with an overflowing treasury, is absolutely helpless against the attack of any third-rate power possessing modern iron-clad vessels armed with heavy rifled cannon.

It would appear unnecessary to present arguments to show the folly of continuing such a condition of affairs, or to prove the necessity of protecting our most important sea-ports and harbors by all the appliances known to the present state of the science and art of war.

The reports of my predecessors have fully and ably set forth our deplorable condition, and the reasons and means for bettering it. I call special attention to the annual reports of the Chief of Engineers for 1881, 1882, and 1884, and earnestly suggest a careful study of the facts and recommendations therein set forth.

The following extract from the Report of The Board of Engineers is presented here as bearing on this matter:

The necessity for immediately beginning the work of reconstructing our sea-coast defenses has been so fully demonstrated heretofore in the annual reports of the Chief of Engineers that no repetition of the arguments is called for here. The only valid reason for delay has been the lack of guns and the impossibility of fabricating in this

country the types demanded by modern progress. Thanks to the recent action of Congress in granting liberal appropriations to prepare the needed factory and to enable our steel manufacturers to procure the needed plant, this necessity no longer exists.

By existing contracts the new gun-factory buildings at Watervliet Arsenal, capable of turning out 12-inch and smaller guns, will be completed by December, 1899, and by December, 1900, plant capable of fabricating annually ten 8-inch, six 10-inch, and four 12-inch guns will be in place. The development of steel industries of the country in the line of heavy ordnance construction has made satisfactory progress and contracts are now let for supplying the steel for fabricating twenty-four 8-inch, twenty-four 10-inch, and fifteen 12-inch guns, that required for forty-four guns, including all three calibers, to be delivered by August, 1902.

Evidently emplacements should be ready to receive this armament as soon as completed. No funds have been appropriated for this purpose, and even if granted at the coming session of Congress they will probably not become available before July 1, 1900. At the estimated rate of fabrication at Watervliet Arsenal ten 8-inch guns will be well advanced toward completion by May, 1899, and three 10-inch guns by May, 1900, while by January, 1903, twenty-four 8-inch, seven 10-inch, and four 12-inch guns should be ready for service.

The Corps of Engineers will thus have only nine months to prepare emplacements for ten 8-inch guns; twenty-one months for three 10-inch guns; and thirty months for twenty-four 12-inch, seven 10-inch, and four 12-inch guns. Fully this time will be required, and no further argument can be needed to prove that the requisite funds should be granted at the next session of Congress.

The necessity for immediate action is hardly less in the case of mortars. Contracts for the material and for finishing and assembling thirty cast-iron steel-bore 12-inch mortars are now let, the whole to be delivered by August, 1902, and they will thus be on hand for mounting by the time the batteries are ready to receive their armament.

The Board on Fortifications, organized under the act of March 3, 1885, and the permanent Board of Engineers have made a careful study of the whole problem, and an efficient system of defense has been prepared and is awaiting construction. It only remains for Congress to give life to the project by making the necessary appropriations.

The main features of this project are:

(1) Armaments of the heaviest rifled guns mounted on disappearing carriages, which, while widely dispersed, can concentrate their fire on the enemy's vessels, and which, in range and penetration of projectiles, will equal if not exceed the heaviest fire that can be brought against them by the most powerful fleet, thus keeping the latter at a safe distance or destroying it while attempting to pass the mined areas.

(2) A well developed system of submarine mines planted in the channels and roadways for the purpose of holding the vessels of the enemy under the fire of our guns and preventing their running the batteries and reaching the harbors and cities.

(3) The protection of these mined areas from counter-mining and removal by batteries of rapid-firing guns of small caliber and wide field of fire.

The great increase in effective range of the present heavy rifles over those of former years has greatly changed the extent and character of the defense. Where formerly 1,000 yards was deemed a safe allowance for the position of fortifications in advance of the city or depot to be defended, 14,000 to 17,000 (8 to 10 miles) is now considered not too far for the exterior line of defense. The city of New York is a fair example. The Battery for an interior and Castle Williams and works on Bedloe's Island for an exterior line, were at one time ample for protection; with the increase in range and accuracy of fire, the Narrows became the necessary exterior line, and now it has advanced to Sandy Hook and Coney Island.

Detailed projects for the defense of our principal sea-board cities and roadsteads have been or are being prepared. Those relating to the gun

defense provide for five classes of works mounting the heaviest rifled ordnance:

- (1) Mortar batteries, with and without scarp walls and flank defenses.
- (2) Barbette batteries armed with guns mounted on disappearing carriages.
- (3) Barbette batteries armed with guns mounted on vertical lift carriages.
- (4) Iron-clad casemated batteries.
- (5) Iron or steel turrets.

The efficiency and economy incident to the first three classes are so well determined that I am prepared to recommend their immediate construction at Boston, New York, Hampton Roads, San Francisco, and Washington, D. C., as the commencement of a comprehensive system of defense, which should be extended to other localities from year to year.

It is not to be understood, however, that the estimates submitted cover the whole project for these places. The complete projects provide for the following ultimate expenditures for batteries, casemates, and turrets, exclusive of armament and platforms for guns, and of gun-carriages and plant for the manipulation of the armament, viz:

Boston:

Masonry and earth-work	\$4, 877, 882
Armor and structural metal	2, 780, 000
Total	7, 657, 882

New York:

Eastern entrance, earth and masonry	2, 190, 000
Southern entrance, masonry and earth-work	7, 006, 496
Armor and structural metal	7, 004, 000
Total	16, 200, 496

Hampton Roads:

Earth-work and masonry	1, 921, 602
Armor and structural metal	1, 715, 000
Total	3, 636, 602

San Francisco:

Earth-work and masonry	5, 935, 000
Project involving use of armor and structural metal not yet prepared.	

Washington:

Masonry and earth-work	520, 000
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The estimates submitted are to be applied to earth-work and masonry covered by earth-work for mortar and barbette batteries for the above places, these being considered the character of works which should receive the earliest attention.

The necessity for a wide distribution of the batteries which concentrate their fire in one channel, and the greater distance at which the exterior line of defense must now be located, render it essential in many places that land now held by private parties should be acquired by purchase or condemnation.

As any initiative towards purchase known to be taken by the Government may result in an undue enhancement in price, and as a contract for purchase at a fixed price can not be made without a specific appropriation, I would strongly recommend the passage by Congress

of an act similar to those of April 24 and August 1, 1888, by which land necessary for the permanent defenses of the country may be obtained by condemnation.

The act of September 22, 1888, appropriated \$200,000[†] for torpedoes for harbor defenses," which included submarine mines and material; casemates and cable-galleries for operating them; continuing torpedo experiments; practical instruction of engineer troops; movable submarine torpedoes.

This sum was allotted as follows :

For casemates and mining galleries.....	\$102,000
For submarine mines and appliances for operating them.....	68,000
For continuing torpedo experiments.....	15,000
For instruction of engineer troops.....	10,000
For purchase of motors for movable torpedoes.....	5,000

These sums have been expended or pledged for the purposes indicated. Casemates and cable-galleries at Forts Wadsworth, Schuyler, and Warren have been begun and are now well under way. The act of March 2, 1889, appropriated \$250,000 for casemates and cable-galleries for operating submarine mines. This sum has been allotted to complete the above casemates and galleries and to begin work on casemates and galleries at Fort at Willets Point and Fort Lafayette, New York, Fort at Sandy Hook, New Jersey, and at Alcatraz Island and Point San José, California, and will be expended or pledged by the close of the present fiscal year. The estimates presented under the head of casemates, cable-galleries, etc., are for completing the above works and constructing others in the more important of our defensive works.

Attention is again invited to the advisability of providing for the repair and preservation of Fort Marion, one of the defensive works of St. Augustine, Fla. It is the oldest and most interesting of all of our fortifications, having been begun by the Spaniards about 1665 under the name of Fort San Marcos. It is a relic of the Spanish occupation and one of the few existing models of its type of fortification, and is well worthy of preservation. St. Augustine is visited every winter by thousands of people from all parts of the United States, and Fort Marion is one of the most attractive features of the place.

An estimate is herewith submitted.

The act of September 22, 1888, made an appropriation of \$117,000 for the construction of sea-walls and for earth embankments. With the approval of the Secretary of War and the Board of Ordnance and Fortification, this was allotted as follows :

For the preservation of site of Fort Niagara.....	\$20,000
For sea-wall and earth embankment at David's Island, New York harbor....	47,000
For sea-wall at Governor's Island, New York harbor.....	50,000

Owing to the stage of water in the lake, the work at Fort Niagara had not been begun at the close of the last fiscal year. It is expected that the work will be soon undertaken and that the amount allotted will be sufficient to complete the repair of the damages to the site which obtained at the time the estimate was submitted. As the encroachment of the lake on the site has since been continuous, it is probable that a further appropriation will be necessary to secure the whole site.

The work at David's Island has been begun and carried well towards completion. The amount allotted will be sufficient to finish the work. (See Appendix 1 A.)

The work at Governor's Island has also been begun, and will be completed, as far as the funds will permit, during the present season. The

original estimate for this work was \$100,000, of which \$50,000 has been allotted as recited above.

An estimate for the completion of the work is submitted.

(See Appendix 1 B.)

ESTIMATES OF APPROPRIATIONS REQUIRED FOR 1890-91.

For construction of gun and mortar batteries at Boston, New York, Hampton Roads, San Francisco, and Washington.....	\$5, 000, 000
For protection, preservation, and repair of fortifications.....	175, 000
For preparation of plans for fortifications	5, 000
For repair and preservation of Fort Marion, Florida, and for construction of sea-wall to preserve the site	15, 000
For purchase of submarine mines and necessary appliances to operate them for closing the channels leading to our principal sea-ports	250, 000
For needful casemates, cable-galleries, etc., from which to operate submarine mines	250, 000
For continuing torpedo experiments, and for practical instruction of Engineer troops in the details of the service	30, 000
For completing sea-wall at Governor's Island.....	50, 000

REPORT OF THE BOARD OF ENGINEERS.

At the date of the last report the Board consisted of the following officers of the Corps of Engineers: Col. Thomas Lincoln Casey, president; Col. Henry L. Abbot, Col. William P. Craighill, Col. C. B. Comstock, Lieut. Col. D. C. Houston, and Maj. William R. King.

On July 6, 1888, Colonel Casey was appointed brigadier-general and Chief of Engineers, and on July 25, 1888, Colonel Abbot was designated president of the Board.

By General Orders No. 2, Headquarters, Corps of Engineers, January 30, 1889, the Board was reconstituted and now consists of the following officers of the Corps of Engineers: Col. Henry L. Abbot, president; Col. C. B. Comstock, Col. D. C. Houston, and Lieut. Col. George L. Gillespie.

The Board has considered the various subjects referred to it during the past year by the Chief of Engineers, and the following is a brief summary of the reports rendered thereon:

1888, July 10. Upon Senate bill 3250 and House bill 10642, for the construction of a bridge across Hudson River, between New York and New Jersey.

July 20. Upon torpedo invention of William Brown, Edinburgh, Scotland.

July 20. Upon proposed bill regulating the acquisition of lands for defensive purposes.

September 26. Upon plan of George J. Murdock for a hydraulic mask for batteries.

September 26. Project for the expenditure of \$200,000 appropriated for submarine mines, torpedoes, cable-galleries, etc.

September 28. Upon the defense of Hampton Roads, Virginia.

October 9. Upon Maj. M. B. Adams's project for expenditure of appropriation of \$35,000 for Burlington Breakwater.

October 9. Upon project of Lieutenant Hunker, U. S. Navy, for establishing rules and the expenditure of \$30,000 under act of June 29, 1888, for the port of New York.

October 9. Estimate of expenditures for The Board of Engineers for the fiscal year ending June 30, 1889.

October 27. Upon request of Treasury Department for quarantine station at Garden, Bird, and Loggerhead Keys, Florida.

October 27. Upon House resolution 176, Fiftieth Congress, first session, for the use of Governor's Island as public park.

November 13. Upon communication of Massachusetts State Board of Health relative to fortifications projected on Deer Island, Massachusetts.

November 23. Upon letter of Pneumatic Dynamite Gun Company relative to number and location of dynamite guns for coast defense.

November 23. Upon plan of military bridges invented by Schneider & Co., of Le Creuzot, France.

December 24. Upon project of Lieut. Col. J. A. Smith for improvement of Kennebec River, Maine.

December 24. Upon letter from Interior Department relative to the boundaries of the San Juan Reservation for military purposes.

December 24. Upon changes necessary or desirable to adapt to our proposed system of fortification the disappearing carriage for a 10-inch breech loading gun submitted by the Pneumatic Gun Carriage and Power Company.

1889. January 5. Project for expenditure of appropriation for torpedoes for harbor defense under act of September 22, 1888.

February 5. Upon project of Lieut. Col. J. A. Smith for improvement of Saco River, Maine.

March 1. Upon project of Lieut. Col. J. A. Smith for improvement of Penobscot River, Maine.

March 6. Upon Lieutenant-Colonel King's report of operations for 1888 and probable operations for 1889 at Willets Point, New York.

April 8. Upon application of Treasury Department to remove buildings of life-saving station to new location at Sandy Hook, New Jersey.

April 20. Upon subject of location of dynamite guns on the Pacific coast.

April 22. Upon location for counterpoise battery to be erected at Fort Hamilton by Mr. Beverly Kennon.

April 22. Relative to location of dynamite guns at Sandy Hook, New Jersey.

April 22. Upon project of Maj. William Ludlow for the use of sand in lieu of stone filling for cribs.

May 4. Upon certain harbors in the Gulf of Mexico and on the South Atlantic coasts, for the information of the Navy-Yard Commission.

May 22. Upon project of Lieutenant-Colonel Barlow for testing new method of maneuvering valves for locks on Muscle Shoals Canal.

May 22. Project for allotment of \$250,000 for torpedoes for harbor defense. (Act of March 2, 1889.)

May 25. Upon location of dynamite guns at Sandy Hook, New Jersey.

June 4. Submitting estimate for the expenses of The Board of Engineers for fiscal year ending June 30, 1890.

June 15. Upon the system of ballooning invented by Mr. Eugene Goddard, of Brussels, Belgium.

June 17. Upon communication of Lieut. Col. J. A. Smith of June 10, 1889, relative to Frost Point Breakwater.

June 17. Upon location of dynamite guns at Forts Schuyler and Warren.

June 21. Upon Maj. M. B. Adams's proposed modifications of project for Gordon's Landing Breakwater.

June 21. Upon the defense of the southern entrance of New York Harbor.

June 27. Upon Colonel Mendell's project of September 17, 1885, for a torpedo-shed for San Francisco Harbor.

June 27. Upon detailed plans for casemates and cable-galleries at Alcatraz Island and Point San José, California.

June 27. Upon plans for a torpedo and torpedo-boat submitted by Mr. John Bowles to the Board of Ordnance and Fortification.

June 27. Upon letter from the Secretary of the Interior to the Secretary of War of June 13, 1889, relative to Point Roberts Military Reservation for defensive purposes.

June 27. Upon the communication of June 10, 1889, from Lieut. H. D. Borup, Ordnance Department, Military Attaché at Paris, France, relative to obtaining information respecting torpedoes.

In the performance of the duties of the Board the following personal examinations were made:

1889, May 23. Visited Sandy Hook, New Jersey, to examine sites for location of batteries.

June 14. Visited Fort Wadsworth, N. Y., to examine sites for location of batteries.

In addition, Colonel Abbot, as a committee of the Board, visited Burlington, Vt., October 5, 1888, and inspected the breakwater at the point.

In addition to their duties with The Board of Engineers, the individual members have been otherwise engaged as follows:

1. Col. Henry L. Abbot, the president of the Board, has continued in charge of certain experiments with torpedoes; was charged, April 1888, with closing the office and accounts and transferring the work lately in charge of Col. Q. A. Gillmore, Corps of Engineers, deceased; was continued a member of the Board of Visitors to Engineer School of Application until January 30, 1889; was detailed as a member of the Board of Ordnance and Fortification on October 25, 1888; served as president of a board for examination of officers of the Corps of Engineers with a view to promotion; was detailed as president of the board to fix the harbor lines of the harbor of New York and adjacent waters on October 5, 1888; was detailed as president of board to fix the harbor lines for the port of Boston on August 13, 1888; was assigned division engineer, Northeast Division, on December 3, 1888; served as president of board to report on plan and location of bridge across Mississippi River at Dubuque, Iowa; has served as president of board to examine and report upon plans for the further improvement of the harbors of St. Augustine and Key West, Fla.; has served as a member of board to report on the purchase of the Kinsley estate near West Point, N. Y.; was detailed to deliver a course of lectures on coast defense at the Naval War College during the term beginning in August, 1888; is charged with the duty of preparing working drawings and estimates for gun lifts after the design proposed by General J. C. Duane.

2. Col. C. B. Comstock has served as division engineer of the Southwest Division since December 3, 1888; as member of the Board of Visitors to the Engineer School of Application; as president of the Mississippi River Commission; as member of the board to fix harbor lines of New York and adjacent waters; as senior member of board on improvement of Winyah Bay, South Carolina; as member of board to fix harbor lines of Philadelphia; as president of board to report on proposed bridge at Louisville, Ky.; as member of two boards for examination of officers for promotion; as member of general court-martial convened at Washington under Special Orders No. 51, A. G. O., 1888.

3. Col. D. C. Houston has been the disbursing officer of The Board of Engineers. He has conducted the various works of river and harbor improvement and of fortifications under his charge, and has served

a member of Board of Visitors to Engineer School of Application; as member of board to fix the harbor lines for the harbor of New York and adjacent waters, and as member of board to consider and report upon the improvement of Winyah Bay, South Carolina.

4. Lieut. Col. George L. Gillespie, in addition to conducting the various works of river and harbor improvement and of fortifications with which he was charged during the year, has served as a member of the Board of Visitors to the Engineer School of Application; of the boards on harbor lines of the port of Boston and of New York Harbor and adjacent waters; of the board to examine and report upon revised project for improvement of Charleston Harbor, South Carolina, and upon project for improving Cumberland Sound and Savannah River below Savannah, Ga.; of the board to carry out the provisions of the act of Congress approved March 2, 1889, in the matter of surveys for deep-water harbor, Gulf of Mexico; of board for the examination of officers of the Corps of Engineers with view to their promotion; and as member of general court-martial, Washington, D. C., March 25, 1889.

The necessity for immediately beginning the work of reconstructing our sea-coast defenses has been so fully demonstrated heretofore in the annual reports of the Chief of Engineers that no repetition of the arguments is called for here. The only valid reason for delay has been the lack of guns and the impossibility of fabricating in this country the types demanded by modern progress. Thanks to the recent action of Congress in granting liberal appropriations to prepare the needful factory and to enable our steel manufacturers to procure the needful plant, this inability no longer exists.

By existing contracts the new gun factory buildings at Watervliet Arsenal, capable of turning out 12-inch and smaller guns, will be completed by December, 1889, and by December, 1890, plant capable of fabricating annually ten 8-inch, six 10-inch, and four 12-inch guns will be in place. The development of steel industries of the country in the line of heavy ordnance construction has made satisfactory progress, and contracts are now let for supplying the steel for fabricating twenty-four 8-inch, twenty-four 10-inch, and fifteen 12-inch guns, that required for forty-four guns, including all three calibers, to be delivered by August, 1892.

Evidently emplacements should be ready to receive this armament as soon as completed. No funds have been appropriated for this purpose, and even if granted at the coming session of Congress they will probably not become available before July 1, 1890. At the estimated rate of fabrication at Watervliet Arsenal, ten 8-inch guns will be well advanced toward completion by May, 1891, and three 10-inch guns by May, 1892, while by January, 1893, twenty-four 8-inch, seven 10-inch, and four 12-inch guns should be ready for service.

The Corps of Engineers will thus have only nine months to prepare emplacements for ten 8-inch guns, twenty-one months for three 10-inch guns, and thirty months for twenty-four 8-inch, seven 10-inch, and four 12-inch guns. Fully this time will be required, and no further argument can be needed to prove that the requisite funds should be granted at the next session of Congress.

The necessity for immediate action is hardly less in the case of mortars. Contracts for the material and for finishing and assembling thirty cast-iron steel-hooped rifled 12-inch mortars are now let, the whole to be delivered by August, 1892, and they will thus be on hand for mounting by the time the batteries are ready to receive their armament.

It is apparent that experiments should be made to test the efficacy of the new batteries and new modes of mounting projected for classes of guns so novel to our service. Such trial batteries can be placed on sites already selected for the permanent defense of New York Harbor, and they will thus become at once available for use in war. It is therefore recommended that the first funds granted be applied to constructing one two-gun lift battery and one sixteen-mortar battery. The estimated cost of the former is \$310,000, and of the latter (including local flanking arrangements) \$200,000.

WHARF AT FORT MONROE, VIRGINIA.

Lieut. Col. Peter C. Hains, Corps of Engineers, in charge.

The construction of this wharf was provided for by the act making provision for the sundry civil expenses of the Government for the fiscal year ending June 30, 1887. The original appropriation was \$100,000. By act approved August 10, 1888, an additional appropriation of \$75,000 was made for the purpose of enlarging the wharf then in course of construction. In accordance with the said act the plans of the wharf were changed, the principal items being the addition of 42 feet to its length and 28 feet to its width. A wooden fender system was also adopted. The officer in charge reports that at the close of the fiscal year 1889 the work was well advanced toward completion. About 2 the iron piles were in place, and the flooring was laid on about one half of the wharf.

July 1, 1888, amount available.....	\$9,670.
Amount appropriated by act of August 10, 1888.....	75,000.
	<hr/>
	84,670.
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$73,626. C9
July 1, 1889, outstanding liabilities.....	8,147. 26
July 1, 1889, amount covered by existing contracts.....	54,277. 36
July 1, 1889, balance available.....	30,619

(See Appendix 2 A.)

IRON PILE BRIDGE OVER MILL CREEK AT FORT MONROE, VIRGINIA.

Lieut. Col. Peter C. Hains, Corps of Engineers, in charge.

By the act making appropriations for the sundry civil expenses of the Government for the fiscal year ending June 30, 1890, an appropriation of \$20,000 was made for the construction of an iron bridge at Mill Creek at Fort Monroe, Va. The work was assigned to the charge of Lieutenant-Colonel Hains, who prepared plans and specifications and advertised for proposals to be opened July 25, 1889.

Amount appropriated by act of March 2, 1889.....	\$20,000.
July 1, 1889, balance available.....	20,000.

(See Appendix 2 B.)

POST OF WILLETS POINT, NEW YORK.—ENGINEER SCHOOL OF APPLICATION.—BATTALION OF ENGINEERS.—ENGINEER DEPOT.

Officer in command, Lieut. Col. W. R. King, Corps of Engineers

POST OF WILLETS POINT, NEW YORK.

At the close of the fiscal year the garrison consisted of 26 commissioned officers and 393 enlisted men.

The improvements made during the year have been only such as could be made with very small allotments of funds available, supplemented by the labor of the garrison.

Brick sidewalks have been laid, wagon roads repaired and graded, a suitable gateway erected at the entrance to the post. The old hospital has been converted into a suitable building for headquarters, and the old headquarters building into four sets of quarters for unmarried officers. The fence around the post cemetery has been completed. The laboratory for enlisted men has been rebuilt. A post canteen and a combined mess for enlisted men has been established, and the target range has been improved and extended.

The improvements recommended are new barracks and mess building for enlisted men; (in this connection attention is earnestly invited to the necessity for new barracks as a sanitary measure, as set forth in the report of Lieut. Col. W. R. King, Corps of Engineers, commanding the post—see Appendix 3;) a suitable building for quartermaster's and commissary stores, including coal bins, etc., and the lighting of the barracks and grounds by electricity; the cleaning out of the ditch or lagoon bordering the post, and the walling in of the ice pond so as to prevent surface water from washing impurities into it.

As this post is one of the largest on the coast it should be made worthy of the place it occupies at the entrance to our greatest sea-port.

SCHOOL OF APPLICATION. .

During the year five engineer officers and two artillery officers completed the course, and eight artillery and infantry officers, who have completed the laboratory duty, are still engaged in the practice work of planting and operating torpedoes, which it is expected will be completed on the 1st of October, 1889.

The plan of detailing infantry as well as artillery officers works well, and it is recommended that it be continued, and that the course be extended to the 1st of October, instead of terminating on the 1st of July, as heretofore, thus giving ten months to the course instead of seven.

Every effort has been made to introduce practical methods of instruction wherever it can be done, and it is believed that officers of industrious habits and fair intelligence can acquire a useful knowledge of the uses of electricity and high explosives, and their application to the torpedo service, even if they have not had the benefit of a thorough scientific education.

BATTALION OF THE CORPS OF ENGINEERS.

The legal strength of the Battalion of the Corps of Engineers is five companies of 150 men each, with a sergeant-major and quartermaster-sergeant, and it is officered by details from the commissioned officers of the Corps.

The present strength is 17 officers and 404 enlisted men.

The authorized strength of Companies A, B, and C, which are stationed at Willets Point, is 133 men each, and of Company E, stationed at West Point, 100 men, an increase of 50 men having been authorized June 13, 1889.

The total losses from all causes during the year have been 122, and the total gains 138, making a net increase of 16 men.

The battalion has been employed during the year at engineer, ponton, and torpedo drill, infantry drill, rifle practice, photography, and Company E, at West Point, has assisted in the instruction of cadets in military engineering and ponton drill.

A detachment of 3 officers and 68 enlisted men from this post and 1 officer and 30 men from West Point was ordered to Johnstown, Pa., on the 5th of June for the purpose of building ponton and trestle bridges to replace, temporarily, those swept away by the great flood which had devastated that region. A portion of the detachment was relieved on the 17th of June, but the balance was still on that duty at the close of the fiscal year.

ENGINEER DEPOT.

The soldiers' laboratory, for which an appropriation of \$6,500 had been made, was completed, furnished with benches, tool-boxes, etc., and occupied, as was also an addition to this building for engines and boilers and dynamos employed in connection with the fish torpedo and search lights. The steamer *Bushnell* was hauled out on the ways and is undergoing thorough repairs and changes necessary to adapt her to the needs of the torpedo service. The officers' laboratory has been repainted and other minor repairs to buildings and property have been made.

The new building for engineer models, etc., for which an appropriation of \$8,000 was made at the last session of Congress, will soon be under way. Instruments have been received (by purchase and transfer), repaired, and issued as the necessities of the service and the funds available would admit.

As there was no appropriation available for torpedo experiments until November last, but little work in that line could be accomplished. Some few experiments were made, however, with explosives, building materials, and with a new motor in Sims' fish torpedo, an account which will be found in the report of the officer in charge. A board of officers to witness and report on the test of the Patrick auto-mob controllable torpedo was appointed in June, 1888, and the test took place before the board in July. The report appears as Appendix 4.

The conclusion of the Board is that this torpedo is worthy of consideration and trial when funds become available.

STATEMENT OF FUNDS.

Congress appropriated for the fiscal year ending June 30, 1889, for engineer depot at Willets Point, N. Y	\$18, 00
Of this there has been expended and pledged	17, 98
Congress appropriated (act of September 22, 1888) for torpedoes for harbor defense	200, 00
And of this there has been assigned to the commanding officer at Willets Point	98, 00
Of this there has been expended and pledged	67, 94
Appropriated for the fiscal year ending June 30, 1890, for engineer depot at Willets Point, N. Y	19, 00
Congress appropriated under the general title "Torpedoes for Harbor Defense" for purchase of submarine mines and the necessary appliances, by act of March 2, 1889, the sum of	250, 00
For continuing torpedo experiments	30, 00
For mining casemate at Willets Point, N. Y., "Allotment"	25, 00

There will be required for the fiscal year ending June 30, 1891—

For incidental expenses of depot	\$5, 00
For purchase of materials for instruction	1, 50
For purchase and repair of instruments	2, 50
For purchase and binding of professional works for the library	5, 00
Total	9, 50

(See Appendix 3.)

RIVER AND HARBOR IMPROVEMENTS.

The funds with which the works for the improvement of rivers and harbors were prosecuted during the last fiscal year were derived from the appropriations by the act of August 11, 1888, and such balances of former appropriations as were available. No appropriation for these works was made at the last session of Congress.

A brief statement, derived from the reports of the officers in charge of the several works hereinafter given, sets forth the condition of each improvement, the extent of work performed during the last fiscal year, the amount expended, and, in compliance with the provisions of the river and harbor acts approved June 23, 1866, and March 2, 1867, an estimate of the amount required for its completion, and of the amount that can be profitably expended in the next fiscal year.

In the preparation of these estimates regard is necessarily had, as a general rule, to the more intimate acquaintance of the engineer officer in charge with the requirements of each locality; the estimates have, however, been carefully revised and amended in this office when deemed advisable, the most economical administration of the works being considered as well as the average of the appropriations made by Congress for each work during the past few years.

Reports are also appended of the work accomplished in the removal of wrecks obstructing or endangering navigation, as provided for in section 4 of the river and harbor act approved June 14, 1880, and enlarged by provision in the river and harbor act of August 2, 1882.

Reports upon the examinations and surveys provided for in the river and harbor act of August 11, 1888, so far as the work has been done, will be found appended to this report, and the remaining reports will be submitted from time to time as soon as possible after the execution of the work, for transmittal to Congress at its ensuing session.

Under the authority given to the Secretary of War in section 12 of the river and harbor act of August 11, 1888, harbor lines have been established at the following localities: Boston, Mass.; New York, East River between Fifty-ninth and Sixty-fourth streets, New York City; Staten Island, New York; Norfolk and Portsmouth, Va.; Savannah and Brunswick, Ga., and Marquette, Mich., of which details are given further on in this report.

The above section provides that beyond such established lines "no piers or wharves shall be extended or deposits made except under such regulations as may be prescribed from time to time by him." As no penalties are prescribed for the violation of this law it is recommended that the attention of Congress be called to the omission with a view to securing the necessary legislation.

Examinations were made whenever required by committees of Congress of proposed bills authorizing the construction of bridges upon which the views of the War Department were desired. Of the bills so examined since my last report to the close of the last session of Congress fourteen originated in the Senate and nine in the House of Representatives.

Examinations were made during the fiscal year of such plans and locations as were submitted by parties interested of bridges proposed to be built over navigable waters subject to the approval of the Secretary of War. A brief statement is given of the action had in such cases.

Reports made in compliance with the requirements of section 2 of the river and harbor act of July 5, 1884, and section 4 of that of August

5, 1886, of instances where bridges, causeways, or other structures erected or in process of erection do or will interfere with free and safe navigation, and also of instances in which piers, breakwaters, or other works built by the United States in aid of commerce or navigation are injured by a corporation or an individual will be found in appendixes X X and Y Y, respectively.

The engineering works in charge of this office have been divided into five divisions, and officers of the corps assigned as division engineers to overlook the work, as follows:

West of the Rocky Mountains: Pacific Division, Colonel Geo. H. Mendell. East of the Rocky Mountains: Northeast Division, Colonel Henry L. Abbot; Southeast Division, Colonel Wm. P. Craighill; Southwest Division, Colonel Cyrus B. Comstock; and Northwest Division, Colonel Orlando M. Poe.

This arrangement for the execution and supervision of the work of the Corps of Engineers is authorized by the new regulations, approved by the Secretary of War February 4, 1889.

Attention is invited to the necessity for legislation to prevent the obstruction of navigable waters, and to protect public works against trespass or injury. Senate bill No. 27, Fiftieth Congress, first session which passed the Senate March 22, 1888, with a slight addition to section 5, and an additional section relative to liability of vessels, would it is believed, accomplish the purpose, and it is recommended that Congress be requested to give the matter early consideration. The following is a copy of the bill, with proposed additions in italics:

AN ACT to prevent the obstruction of navigable waters and to protect public works against trespass or injury.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That it shall not be lawful to cast, throw, empty, or unload, cause, suffer, or procure to be cast, thrown, emptied, or unladen, either from or on any ship, vessel, lighter, barge, boat, or other craft, or from the shore, pier, wharf, furnace, manufacturing establishments, or mills of any kind whatever, any ball, stone, slate, gravel, earth, rubbish, wreck, filth, slabs, edgings, sawdust, slag, cinders, ashes, refuse, or other waste of any kind, into any port, road, roadstead, harbor, navigable river, or navigable waters of the United States which shall tend to impede or obstruct navigation, or to deposit or place or cause, suffer, or procure to be deposited or placed, any ballast, stone, slate, gravel, earth, rubbish, wreck, filth, slabs, edgings, sawdust, or other waste in any place or situation on the bank of any navigable waters where the same shall be liable to be washed into such navigable waters either by ordinary or high tides, or by storms or floods, or otherwise, whereby navigation shall or may be impeded or obstructed: *Provided*, That nothing herein contained shall extend or be construed to extend to the casting out, unloading, or throwing out of any ship or vessel, lighter, barge, boat, or other craft any stones, bricks, lime, or other materials used, or to be used, in or toward the building, repairing, or keeping in repair any quay, pier, wharf, weir, bridge, building, or work lawfully erected or to be erected on the banks or sides of any port, harbor, channel, or navigable river, or to the casting out, unloading, or depositing of material excavated for the improvement of navigable waters into such place in such manner as may be deemed by the United States officer supervising said improvement most judicious and practicable and for the best interests of such improvements, or to prevent the depositing of any substance above mentioned under any authority from the Secretary of War, which he is hereby authorized to grant, in any place designated by him where navigation will not be obstructed thereby.

SEC. 2. That it shall not be lawful to build any wharf, pier, dolphin, boom, weir, breakwater, bulkhead, jetty, or other structure outside established harbor without the permission of the Secretary of War in any port, roadstead, haven, navigable river, or other waters of the United States in such manner as shall obstruct or impair navigation, commerce, or anchorage of said waters; and it shall not be lawful hereafter to commence the construction of any bridge, bridge-draw, bridge and abutments, causeway, or other works over or in any port, road, roadstead, harbor, navigable river, or navigable waters of the United States, under any authority from the legislative assembly of any State, until the location and plan of such bridge

been submitted to and approved by the Secretary of War, or to excavate or fill, or in any manner to alter or modify the course, location, condition, or capacity of the channel of said navigable waters of the United States, unless approved and authorized by the Secretary of War: *Provided*, That this section shall not apply to any bridge, bridge-draw, bridge piers and abutments the construction of which has been heretofore duly authorized by law, or be so construed as to authorize the construction of any bridge, draw-bridge, bridge piers and abutments, or other works, under an act of the legislature of any State, over or in any stream, port, roadstead, haven, or harbor, or other navigable water not wholly within the limits of such State.

SEC. 3. That all wrecks of vessels, and other obstructions to the navigation of any port, roadstead, harbor, or navigable river, or other navigable waters of the United States, which may have been permitted by the owners thereof or the parties by whom they were caused to remain to the injury of commerce and navigation for a longer period than two months, shall be subject to be broken up and removed by the Secretary of War, without liability for any damage to the owners of the same.

SEC. 4. That it shall not be lawful for any person or persons to take possession of or make use for any exclusive purpose, build upon, alter, deface, injure, obstruct, or in any other manner impair the usefulness of any sea-wall, bulkhead, jetty, dike, levee, wharf, pier, or other work built by the United States for the preservation and improvement of any of its navigable waters, or boundary marks, tide-gauges, surveying-stations, buoys, or other established marks, nor remove for ballast or other purposes any stone or other material composing such works.

SEC. 5. That every person, persons, or corporation offending against the provisions of this act shall, for each and every such offense, forfeit and pay a penalty of two hundred and fifty dollars, besides such other sum as may be found, in any action for the recovery of the penalty or penalties incurred under this act to be the expense of making good the damage incurred or of removing to a proper place the things deposited in violation of this act, such penalties to be recovered by action in the name of the United States in any district court within whose jurisdiction such offense shall be committed, or in any district wherein the defendant may be found, said action to be instituted by the district attorney for such district at the instance of any person complaining.

SEC. 6. *Any damage for injury done to any of the property of the United States mentioned in section four of this act by any vessel shall be a lien upon such vessel, her machinery, apparel, and furniture, the payment of which may be enforced by the United States in a suit instituted in the admiralty court of the district wherein said injury was done, or in the district where said vessel may be found.*

SEC. 7. That it shall be the duty of officers and agents having the supervision, on the part of the United States, of the works in progress for the preservation and improvement of said navigable waters, and, in their absence, of the United States collectors of customs and other revenue officers, to enforce the provisions of this law by giving information to the district attorney of the United States for the district in which any violation of any provision of this act shall have been committed.

Under sections 9 and 10 of the river and harbor act of 1888, persons or corporations owning or controlling bridges over navigable waters of the United States, obstructing the free navigation of said waters, were notified in twenty-nine instances to so alter the bridges as to render navigation through or under them free, easy, and unobstructed, and in each case a reasonable time was prescribed within which such alteration is to be made.

Section 3717 of the Revised Statutes requires that "whenever the Secretary of War invites proposals for any works, or for any material or labor for any works, there shall be separate proposals and separate contracts for each work, and also for each class of material or labor for each work."

The restrictions imposed by the section in a certain class of cases operate injuriously. For instances, it not infrequently happens that appropriations of small sums are made for improvements which may be grouped within certain bounds or regions of no great extent, such as the eastern shore of the Chesapeake Bay, or the sounds of North Carolina, etc. As the law now stands, each individual improvement must be advertised and contracted for separately, though the work be the same in all, say dredging. A bidder in proposing for each work must do so without any regard to the other works in the region. He may be the

lowest for one work but not the lowest for any other, and he is awarded the contract for the one work only, of course. To get his plant and force to the region and remove it therefrom costs just as much for one work as for several, and his price for each work, to make him secure, must be such as will provide for this transportation of plant in addition to the cost proper of doing the work.

In such cases considerable economy would result, and more work could be done at each point appropriated for, if the restrictions imposed by the statute were removed. The restrictions might still remain where the nature of the work is essentially different and the improvements are not in the same region of country.

South Pass of the Mississippi River.—During the fiscal year ending June 30, 1889, the channel has been maintained as required by law, except from December 28, 1888, to January 4, 1889, both dates inclusive.

Section 5 of the river and harbor act of August 11, 1888, authorizes the Secretary of War to make such rules and regulations for the navigation of the South Pass of the Mississippi River as to him shall seem necessary or expedient for the purpose of preventing any obstruction to the channel and injury to the works, and prescribes certain penalties for violations of rules and regulations made by him in pursuance of the act.

Rules and regulations were made by the Secretary of War, and published in newspapers and widely distributed. There have been numerous violations of these rules and regulations, and the parties have been indicted by the grand jury. It is understood that the attorneys for the defense maintain that while Congress undoubtedly had authority to establish the rules and regulations, the power could not be delegated and therefore the rules and regulations established by the Secretary of War are unconstitutional. The decision of the United States circuit court in the matter has not yet been reached.

In view of these facts the United States attorney for the eastern district of Louisiana recommended that no action be taken in the last violation of the rules and regulations reported until a decision of the court is reached, which recommendation was concurred in by the Attorney General.

The following draught of a bill is submitted with the recommendation that Congress be requested to act upon it in order to secure the object desired:

AN ACT to prevent any obstructions to the navigation of the South Pass of the Mississippi River and to prevent any injury to the works therein constructed.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That for the purpose of preventing any obstruction to the navigation of the South Pass of the Mississippi River, and any injury to the works therein constructed, the following rules and regulations are hereby established:

1. Steam-vessels navigating the South Pass are required to reduce their speed to not exceeding ten miles per hour, and from the pilot's station at Picayune Bay to the sea end of the jetties the speed shall not exceed six miles per hour.

2. All vessels anchoring in the pass shall take position near the eastern bank of the pass above a point marked by a post painted white, and below the island at the head of the pass; and vessels so anchoring shall put out such extra moorings as may be necessary to prevent their being blown athwart the channel and thus endanger the navigation of the pass, whenever required to do so by the United States Indian Officer of the works for the improvement of the pass.

3. No master or other person in command of a vessel drawing more than 12 feet of water, shall enter the jetty channel from sea with such vessel until after a descending vessel which has previously entered said channel from above has passed the jetties, and likewise no such vessel descending the river shall enter the channel at the head of the pass until after an ascending vessel, which shall have passed the head of the pass, has passed through the entrance at the head of the pass.

4. All vessels discharging or waiting to discharge ballast at Port Eads shall be moored to the bank by lines, and no vessel shall discharge ballast into the

Mexico within a distance of five miles from the sea ends of the jetties; nor shall ashes or other refuse matter which may be liable to cause a shoaling or filling up of South Pass be dumped therein.

5. The dredge-boat *G. W. R. Bayley* shall have the exclusive right of way over all vessels navigating South Pass while she is at work therein, and all vessels in passing her must be governed by her signals; she shall give the usual steam-whistle signal for passing to her port or starboard, and this shall be responded to and obeyed by the passing vessel on the order of its master or pilot.

6. Tow boats with tows are not permitted to go down the pass after dark, but must anchor above the head of the passes till after daylight.

The term "South Pass" as herein employed shall be construed as embracing the entire extent of channel between the upper ends of the works at the head of the pass and the outer sea end of the jetties at the entrance from the Gulf of Mexico.

SEC. 2. Any person who shall willfully violate any of the above enumerated rules or regulations shall be guilty of a misdemeanor, and on conviction thereof shall pay a fine not exceeding five hundred dollars, and undergo an imprisonment not exceeding six months at the discretion of the court.

ATLANTIC COAST AND GULF OF MEXICO.

IMPROVEMENT OF RIVERS AND HARBORS IN THE STATES OF MAINE AND NEW HAMPSHIRE.

Officer in charge, Lieut. Col. Jared A. Smith, Corps of Engineers.

1. *Lubec Channel, Maine*.—This channel lies between the eastern extremity of Maine and Campo-Bello Island, belonging to the Dominion of Canada. Originally the channel was but 5 feet in depth at mean low water, and but 2 feet at low water of spring tides.

The original project of improvement adopted in 1879 proposed widening and deepening the channel by dredging, where necessary, from the Narrows to the Western Bar Beacon, so as to give a width of 200 feet and a depth of 12 feet at mean low water, or 9 feet at low water of spring tides. This part was completed in 1883.

The present project contemplates increasing the width to 275 feet, and to 300 feet in the bends. Length of channel $2\frac{1}{2}$ miles.

The amount expended upon this improvement to June 30, 1888, was \$148,989.97.

The resulting improvement to navigation has been great, as it has made a channel 12 feet deep at mean low water for a width varying from 200 to 278 feet, besides a stone jetty at the narrows to direct the current.

The channel, however, is not straight, and tidal currents are very strong so that the thoroughfare is not as well adapted to the necessities of the commerce as could be desired.

During the last fiscal year there has been expended the sum of \$503.26. This expense was for preparatory work, as the appropriation of August 11, 1888, became available too late to commence dredging before spring.

Under the last appropriation a contract has been let for continuing the work, and under this contract the improvement will be fully completed as heretofore approved:

July 1, 1888, amount available.....	\$10. 03
Amount appropriated by act of August 11, 1888.....	20, 000. 00
	<hr/> 20, 010. 03
July 1, 1889, amount expended during fiscal year, exclusive of	
liabilities outstanding July 1, 1888.....	\$503. 26
July 1, 1889, amount covered by existing contracts.....	18, 000. 00
	<hr/> 18, 503. 26
July 1, 1889, balance available.....	1, 506. 77

(See Appendix A 1.)

2. *Moose-a-bee Bar, Maine.*—The project for this improvement was adopted in 1881, and modified in 1888, the object being to give a direct channel 300 feet wide, and a depth of 14 feet at mean low water over the bar, and to remove ledges near and in the channel to a depth of 16 feet.

The entire amount expended to June 30, 1888, was \$31,841.77.

The dredged channel was made 200 feet wide in 1885. To complete the present project there remains the widening of channel to 300 feet, and removal of ledges.

Under the appropriation of August 11, 1888, a contract has been let to widen the channel by dredging.

During the last fiscal year there has been expended \$791.87.

Fifty cubic yards of rock were removed from Steamboat Ledge, but no benefit will result until its entire removal is completed.

The appropriation asked is to be applied to the removal of ledges and completing small jetty to check the currents.

July 1, 1888, amount available, including amounts covered by existing contracts.....	\$8, 158. 23
Amount appropriated by act of August 11, 1888	15, 000. 00
	<hr/> 23, 158. 23

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$710. 87
July 1, 1889, outstanding liabilities.....	81. 00
July 1, 1889, amount covered by existing contracts.....	20, 488. 80
	<hr/> 21, 280. 67

July 1, 1889, balance available.....	<hr/> 1, 877. 56
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{ Amount (estimated) required for completion of existing project.....	95, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	25, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 2.)

3. *Narraguagus River, Maine.*—The obstruction to navigation consisted in a bar extending from the anchorage known as "Deep Hole," near Fickett's Point, to deep water, the shoalest part having only 4 feet at extreme low water, and only 5½ feet at mean low water.

The project for improvement adopted in 1886 consists in dredging a channel 11 feet deep at low water to the steam-boat landing at Long Point, and thence 9 feet deep to the deep hole, or anchorage; the width of the channel to be 200 feet throughout, except in the reach by the steam-boat wharf, where it is to be increased to 300 feet.

The amount expended to June 30, 1888, was \$10,000. As a result a channel 11 feet deep was dredged to the lower steam-boat wharf, a distance of 5,000 feet, of which 3,500 feet was 50 feet wide, and the remaining distance 75 feet wide.

The lower wharf can now be reached at all ordinary low stages; but this is of little value, as steamers must wait for high water before they can turn around to return.

During the last fiscal year no work has been carried on. Under the appropriation of August 11, 1888, a contract has been let to continue the dredging in the channel.

The contractor is required to commence work early in July, and to complete it on or before December 31, 1889.

The appropriation asked is to be expended in completing the project.

The improvement being at a point distant from commercial centers,

and the amount for its completion being small, the sum should be provided in a single appropriation.

Amount appropriated by act of August 11, 1886	\$20,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$250.58
July 1, 1889, amount covered by existing contracts	9,942.00
	<hr/> 9,250.58
July 1, 1889, balance available	<hr/> 791.42
<hr/>	
{ Amount (estimated) required for completion of existing project	30,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	15,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix A 3.)	

4. *Breakwater from Mount Desert to Porcupine Island, Maine.*—The anchorage and landing at Bar Harbor is entirely exposed to storms and seas setting in from southerly directions.

Under requirements of the river and harbor act of August 5, 1886, an examination of the harbor was made, and a report, with plan and estimate for a breakwater from Mount Desert to Porcupine Island, was submitted by the engineer officer in charge. Page 483. Report of Chief of Engineers, 1887.)

Congress having appropriated \$50,000 for commencing the work, the plan submitted has been adopted.

A contract has been entered into for the delivery of stone in the breakwater.

The contractors have been making active preparations for carrying on the work, opening a quarry and obtaining vessels.

The delivery of stone will be commenced in July and will be continued under the contract as far as available funds permit.

Amount appropriated by act of August 11, 1888	\$50,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$302.54
July 1, 1889, amount covered by existing contracts	45,000.00
	<hr/> 45,302.54

July 1, 1889, balance available	<hr/> 4,697.46
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{ Amount (estimated) required for completion of existing project	750,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	100,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 4.)

5. *Bagaduce River, Maine.*—The river and harbor act of August 5, 1886, required an examination or survey of the Bagaduce River, Maine.

A report, with estimate of cost of works considered necessary, was submitted by the engineer officer in charge, February 2, 1888. See Report of Chief of Engineers for 1888, page 401.

The project adopted for the improvement consists of deepening the channel to give a width of 100 feet and a low-water depth of 6 feet from South Penobscot to Bridge's Point. This includes dredging and removing rocks. The project also includes removing a small amount of rock in Johnson's Narrows.

By act of August 11, 1888, Congress appropriated \$3,000 for the improvement. As this small sum could not be judiciously expended in a way to accomplish any beneficial result, work on the improvement has been suspended to await the further appropriations.

An expenditure of \$100 from the appropriation has been incurred in the necessary office work, preparing plans, estimates, etc.

To effect any valuable improvement of the channel all the rock must be first removed; but little result can come from the removal of a portion only.

The estimate of \$24,427.90 for removing all the rock will probably not cover the expense if it can not be done under one contract.

Amount appropriated by act of August 11, 1888.....	\$3,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	100.00

July 1, 1889, balance available.....	2,900.00
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{ Amount (estimated) required for completion of existing project.....	43,875.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 5.)

6. *Penobscot River, Maine.—Bangor to Crosby's Narrows.*—The present project for this improvement consists in widening the channel to 300 feet by dredging opposite Bangor to a depth of 11 feet at extreme low water; also to widen the channel and remove obstructions in Crosby's Narrows.

The estimated cost of the entire improvement was \$75,000.

The former channel at Bangor was too narrow to accommodate the numerous vessels, in connection with the lumber rafts, which often require much space.

There was expended upon the work to June 30, 1888, the sum of \$24,795.07. The result was the required increase of width for more than half a mile, and a partial widening for most of the remaining distance required opposite Bangor.

Work under the contract mentioned in last annual report was completed September 24, 1888.

The amount expended during the year has been \$10,144.76.

This has resulted in completing the widening of channel at Bangor as heretofore planned.

A contract has been completed for expenditure of funds now available in widening the channel by dredging at Crosby's Narrows.

Under the requirements of the river and harbor act of August 5, 1886, a preliminary examination and survey were made of the Penobscot River, from Bangor to Bucksport, Me. A report of the results of the survey was transmitted to Congress February 8, 1888. (See Report of Chief of Engineers for 1888, pages 425 to 431).

The officer in charge estimates the cost of the improvement at \$365,000.

The act of August 11, 1888, having apportioned a portion of the appropriation to this part of the river improvement, plans have been completed and advertisements issued inviting proposals for dredging to deepen the channel. If suitable prices are obtained the work will be done by contract during the ensuing year.

The amount of \$821.73 expended during the fiscal year has been for making a complete examination of the character of the material in the channel, and for the necessary preparatory work in office.

The appropriation for year ending June 30, 1891, will be expended in completing the work at Crosby's Narrows, and in continuing the improvement between Bucksport and Winterport.

July 1, 1888, amount available, including amounts covered by existing contracts.....	\$10,204.93
Amount appropriated by act of August 11, 1888.....	50,000.00
	<hr/> 60,204.93

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$10,966.49
July 1, 1889, amount covered by existing contracts	18,000.00
	<hr/> 28,966.49

July 1, 1889, balance available	31,238.44
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{ Amount (estimated) required for completion of existing project.....	355,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	50,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 6.)

7. *Belfast Harbor, Maine.*—The harbor was originally shallow along the wharf-fronts east side, so that vessels could only land on high stages of water. A project for the improvement of this harbor was adopted in 1876, the object being to enable vessels drawing 10 to 12 feet of water to reach the wharves at all stages of the tide.

Up to June 30, 1887, there had been expended the sum of \$22,213.84.

The west side of the harbor has been improved so that there is 10 feet at mean low water in the upper part and 11 to 12 feet in the lower part.

In January, 1888, a special examination was made of the harbor, and the report dated February 2, 1888, recommended that the area of the harbor be increased by dredging on the northeast side. (See Report Chief of Engineers, 1888, pages 381 and 382.)

The river and harbor act of August 11, 1888, required an examination or survey of the harbor. A report of a preliminary examination was submitted by the officer in charge. The harbor having been reported worthy of improvement, he has been directed to make a survey of the harbor and to submit a plan of improvement with estimate of cost. The survey will be made during the ensuing summer.

July 1, 1888, amount available	\$2,786.16
July 1, 1889, balance available	2,786.16

(See Appendix A 7.)

8. *Camden Harbor, Maine.*—Under the provisions of the river and harbor act of August 5, 1886, an examination and survey were made of Camden Harbor. The preliminary report and report of survey are included in Report of Chief of Engineers for 1888, pages 403 to 407.

The harbor is so shoal that at mean low water vessels drawing more than 6 feet can not reach the wharves. The following is the project adopted for its improvement:

First. Dredging approaches to depth of 12 feet.

Second. Dredging channels to depth of 10 feet.

Third. Removing middle ground.

The river and harbor act of August 11, 1888, having appropriated \$5,000 for commencing the improvement, plans have been perfected and a contract has been made for dredging as far as funds permit.

The expenditures during the fiscal year have been \$94.86.

It is proposed to spend the funds available, and for which estimates are submitted, in carrying on the improvement in the order named.

Amount appropriated by act of August 11, 1888.....	\$5,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$94.86
July 1, 1889, amount covered by existing contracts.....	4,500.00
	<u>4,594.86</u>

July 1, 1889, balance available..... 405.14

{ Amount (estimated) required for completion of existing project.....	54,930.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	12,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 8.)

9. *Rockport Harbor, Maine.*—This harbor is upon the west side of Penobscot Bay, about 6½ miles north of Rockland.

The upper portion of the harbor is shallow, so that vessels of any size can not reach the upper wharves save in high stages of the tide.

In the winter the harbor is much obstructed by ice.

The project for improving the harbor consists in dredging the upper part to a depth of 12 feet at mean low water.

The river and harbor act of August 11, 1888 appropriated \$10,000 for the work. Plans have therefore been perfected and a contract has been let for dredging as far as funds permit.

The original estimate for the entire improvement was but \$14,000, and was based upon the presumption that it could be done in a single season under one appropriation.

As prices for such work are greatly increased when work is done in small amounts it is not probable that the project can be completed without exceeding the original estimated cost, which is therefore amended.

Amount appropriated by act of August 11, 1888.....	\$10,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$178.68
July 1, 1889, amount covered by existing contracts.....	9,000.00
	<u>9,178.68</u>

July 1, 1889, balance available..... 821.32

{ Amount (estimated) required for completion of existing project.....	5,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	5,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 9.)

10. *Rockland Harbor, Maine.*—The project for improving this harbor adopted in 1881, consists in the construction of two breakwaters to protect the shipping in the harbor and to make it a harbor of refuge. The harbor was open to all easterly winds and seas, and the breakwaters, when completed, will afford still water and good anchorage.

There had been expended on the improvement to June 30, 1888, the sum of \$120,316.40.

As a result, the breakwater from Jameson's Point had been completed its full length of 1,900 feet from high-water mark on shore, and to a height of 5 feet above mean low water. It has been found necessary to raise the top to mean high-water level, and this work has been commenced at the outer extremity.

During the year ending June 30, 1889, there has been expended the sum of \$12,129.37.

As a result, 13,599 tons of stone have been placed upon the breakwater. The distance from outer end, completed to full dimensions, is 642 feet.

The raising of Jameson's Point breakwater to high-water level is now in progress under contract with Mr. John F. Hamilton, of Portland, Me. Under this contract all available funds will be expended.

It is proposed to expend the next appropriation in extending the Jameson's Point breakwater, or in commencing the second breakwater, as may in future be deemed most advantageous.

July 1, 1888, amount available.....	\$2, 183. 40
Amount appropriated by act of August 11, 1888	30, 000. 00

	32, 183. 40
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$12, 129. 37
July 1, 1889, outstanding liabilities.....	1, 891. 70
July 1, 1889, amount covered by existing contracts.....	15, 971. 51
	29, 992. 58

July 1, 1889, balance available	2, 190. 82
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{ Amount (estimated) required for completion of existing project.....	497, 500. 00
{ Amount that can profitably be expended in fiscal year ending June 30, 1891	75, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 10.)

11. *Kennebec River, Maine.*—The navigation of the river is much obstructed by shoals in both channels at Swan Island, and in other places above; by ledge of rock at Lovejoy's Narrows, and in harbor at Bath; also by bridge piers at Hallowell.

The project for improving the river consists in removing the shoals by contraction works, and by dredging, and removing rocks by blasting.

The river and harbor act of August 11, 1888, appropriated \$75,000 for commencing the improvement.

The work of completing improvement at Hatch's Rock Shoal and commencing work at Beef Rock Shoal has been let by contract, and active operations are now in progress.

The amount expended during the fiscal year in preparatory work and in constructing wing-dams at Hatch's Rock is \$6,186.54.

The balance of available funds will be expended under the present contract.

It is proposed to expend funds which may be appropriated in carrying out the project, as indicated.

(See Report of Chief of Engineers, 1888, pages 412 to 425.)

Amount appropriated by act of August 11, 1888.....	\$75, 000. 00
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July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$1, 361. 60
July 1, 1889, outstanding liabilities.....	4, 824. 94
July 1, 1889, amount covered by existing contracts.....	65, 175. 06
	71, 361. 60

July 1, 1889, balance available.....	3, 638. 40
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{ Amount (estimated) required for completion of existing project.....	335, 500. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	75, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 11.)

12. *Harbor at Portland, Maine.*—Before the adoption of the present project for improving this harbor there was but 21 feet of water to the wharves used by transatlantic steamers. The large steamers frequently draw as much as 27 feet, and a greater depth was needed in the chan-

nel. The project for improving the channel involves dredging a channel 500 feet wide and 29 feet deep at low water to the wharves used by largest steamers.

Previous to June 30, 1888, there had been expended upon the improvement the sum of \$29,992.34.

As a result an area about 1,600 feet long and 400 feet wide along the wharf front had been dredged to the required depth of 29 feet at mean low water.

During the last fiscal year there has been expended the sum of \$37,253.29.

This has resulted in connecting the area on wharf front with deep water outside, by a channel approximately 2,800 feet long and 227 feet wide.

The completion of the channel will be a great benefit to the facilities for receiving and shipping by transatlantic steamers and other large vessels.

The funds available and such as may be appropriated will be expended in completing the project described.

July 1, 1888, amount available.....	\$7. 66
Amount appropriated by act of August 11, 1888.....	40,000. 00
	<hr/> 40,007. 66

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$26,620. 80
July 1, 1889, outstanding liabilities	10,632. 49
	<hr/> 37,253. 29

July 1, 1889, balance available.....	2,754. 37
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{ Amount (estimated) required for completion of existing project	65,000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	65,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 12.)

13. *Channel in Back Cove, Portland, Maine.*—The project for this improvement, adopted in 1886, consists in widening and deepening the channel to give 12 feet depth at mean low water and a width of 300 feet for a distance of about 5,600 feet, following the harbor commissioners' line.

Originally the channel was only navigable at high stages of water. It was but 8 feet deep at low water, and that depth did not extend more than half its length.

Amount expended to June 30, 1888, \$10,728.39.

Amount expended during the last fiscal year, \$22,333.71.

As a result the channel previously dredged has been extended so that its total length is 4,030 feet, with a bottom width of 72 feet and a depth of 12 feet at mean low water. Work under the contract previously reported was completed October 30, 1888.

A total of 136,496 cubic yards of material measured *in situ* was removed from the channel, of which 86,894 were removed subsequent to June 30.

A contract has been concluded for continuing the dredging, and work under this contract was commenced June 1, 1889, and 27,236 cubic yards, scow measurement, have been removed.

Fifty thousand dollars could be profitably expended in each year until the improvement is complete. The amount available, and that asked, are to be applied to extending and widening the channel.

The widening the channel as planned will greatly increase the facilities for receiving and shipping numerous freights, such as coal and building materials.

July 1, 1888, amount available, including amounts covered by existing contracts	\$15,521.61
Amount appropriated by act of August 11, 1888	25,000.00

40,521.61

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$20,796.79
July 1, 1889, outstanding liabilities	1,536.92
July 1, 1889, amount covered by existing contracts	16,343.96

38,677.67

July 1, 1889, balance available	1,843.94
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{ Amount (estimated) required for completion of existing project	128,750.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	50,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 13.)

14. *Breakwater at mouth of Saco River, Maine.*—This breakwater was partially built in 1869 to 1873. In 1883 it was found necessary to complete the breakwater to the full height of 15 feet and top width of 12 feet to secure the object of preventing the sand from drifting into the channel and maintaining a bar at the mouth of the Saco River.

There had been expended upon this work to the 30th of June, 1888, the sum of \$27,498.52.

As a result the breakwater had been completed from its outer end a distance of 1,310 feet and partially repaired a further distance of 292 feet.

The repairing of the breakwater has had no perceptible effect in increasing the depth of water on the bar.

At the close of the last fiscal year the available funds had been practically expended.

Congress having appropriated \$12,500 by act of August 11, 1883, a contract has been awarded for continuing the work as far as available funds permit.

Work under the contract will be completed during the ensuing year.

July 1, 1888, amount available	\$1.48
Amount appropriated by act of August 11, 1888	12,500.00

12,501.48

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$348.57
July 1, 1889, outstanding liabilities	9.05
July 1, 1889, amount covered by existing contracts	11,161.00

11,518.62

July 1, 1889, balance available	982.86
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{ Amount (estimated) required for completion of existing project	30,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	30,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 14.)

15. *Saco River, Maine.*—The project for improving the Saco River includes the works considered necessary to give a channel, having not less than 6 feet depth at low water, to the cities of Saco and Biddeford.

The channel was obstructed by a bar, by shoals, and in one place by a ledge, and does not afford a continuous depth exceeding $3\frac{1}{2}$ feet at low water, though much of the channel is deeper. The revised estimate of the entire expense is \$155,000.

There has been appropriated \$22,500. Expenditures to June 30, 1888, \$12,436.32. Expended in last fiscal year, \$5,077.11. The results thus far, though improving the depth in the river channel at Little Islands, has not increased the available depth over the bar, nor in the upper part of river, so that no greater draught of vessels can be used until other parts are improved.

A contract has been made for expenditure of available funds, completing the training-wall above Little Islands, and in commencing wing-dam at Cow Island.

It would be economical and advantageous to complete the jetty over the bar at once, and in a single year. The amount asked is for this purpose.

July 1, 1888, amount available.....	\$63. 68
Amount appropriated by act of August 11, 1888	10, 000. 00
	<hr/> 10, 063. 68
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$3, 028. 41
July 1, 1889, outstanding liabilities	2, 048. 70
July 1, 1889, amount covered by existing contracts.....	4, 683. 87
	<hr/> 9, 760. 98
July 1, 1889, balance available.....	302. 70
	<hr/>
{ Amount (estimated) required for completion of existing project.....	132, 500. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	25, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix A 15.)	

16. *Kennebunk River, Maine.*—All the projects for improving this river have been completed.

There have been no appropriations since 1881.

The works completed consist of stone piers, supplemented by crib-work to keep the channel open at and near the mouth.

Total expended to June 30, 1888, \$65,075.58.

The small amount of \$22.80 expended in last fiscal year has been for making charts of the channel and for other contingent expenses.

An examination of the river has been made and reports have been submitted by the officer in charge of the work.

July 1, 1888, amount available.....	\$99. 42
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	22. 80
	<hr/> 76. 62
July 1, 1889, balance available.....	76. 62
(See Appendix A 16.)	

17. *York Harbor, Maine.*—The project for this improvement, adopted in 1886, has for its object the widening of the channel in three bends where it did not exceed 75 feet of a navigable depth, and where the tidal currents are very rapid. The channel at the points mentioned is to be widened by dredging and removing such rock as may be found.

Expenditures to June 30, 1888, \$12,928.11.

Expended in last fiscal year \$293.72.

A contract has been made for expenditure of available funds in removing the ledge at Stage Neck. This will result in greatly improving

the entrance and utilizing the work hitherto done, though a part of the ledge will still remain.

July 1, 1888, amount available.....	\$2,071.89
Amount appropriated by act of August 11, 1888	10,000.00
	<hr/> 12,071.89
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$293.72
July 1, 1889, amount covered by existing contracts.....	10,800.00
	<hr/> 11,093.72
July 1, 1889, balance available.....	<hr/> 978.17
<hr/>	
{ Amount (estimated) required for completion of existing project.....	19,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	19,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix A 171.)	

18. *Harbor at Portsmouth, New Hampshire.*—The project for improving this harbor was adopted in 1879, the object being to check the strong tidal currents in the harbor, and to give a navigable depth over the ledge known as Gangway Rock, opposite the navy-yard.

Expenditures to June 30, 1888, \$106,604.94; expenditures in last fiscal year, \$1,074.20.

The results are the entire removal of Gangway Rock to a depth of 20 feet at mean low water, the completion of the breakwater to stop the cross-currents coming in from between Great and Goat Islands, and a removal of part of the ledge projecting from Badger's Island.

There remains to complete the original project only the removal of the remaining ledge on the point projecting from Badger's Island.

It has been decided as unadvisable to complete the original project of removing the ledge on Badger's Island to 10 feet.

A contract has been made for expenditure of available funds in removing the ledge to a depth of 18 feet.

July 1, 1888, amount available.....	\$395.06
Amount appropriated by act of August 11, 1888	15,000.00
	<hr/> 15,395.06
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$1,074.20
July 1, 1889, amount covered by existing contracts.....	13,511.06
	<hr/> 14,585.26
July 1, 1889, balance available.....	<hr/> 800.80
(See Appendix A 18.)	

19. *Bellamy River, New Hampshire.*—The project for this improvement consists in dredging the channel of the river to give a depth of 5 feet at mean low water and a width of 50 feet at the bottom.

The river is a tidal arm of Great Bay, which connects with the Piscataqua River at Dover Point, 4 miles above the bridge at Portsmouth, N. H.

The object of the improvement is to obtain a channel which will enable vessels of 500 or more tons to ascend to head of navigation at high tide.

The improvement was estimated to cost \$28,000.

Congress having made an appropriation for commencing the work, a contract has been made for dredging the channel as far as available funds permit.

Dredging was commenced May 1, 1889. June 30, 22,700 cubic yards of material had been removed, resulting in an improved channel for a distance of 3,500 feet.

Total expenditures, \$5,205.33.

It is proposed to expend available funds, and the appropriation asked, in dredging to complete the project.

Amount appropriated by act of August 11, 1888.....	\$10,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$4,757.01
July 1, 1889, outstanding liabilities.....	448.32
July 1, 1889, amount covered by existing contracts.....	4,516.75
	<hr/> 9,722.03
July 1, 1889, balance available,	277.92
	<hr/>
{ Amount (estimated) required for completion of existing projects.....	18,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	18,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 19.)

20. *Cocheco River, New Hampshire.*—The project for improving the Cocheco River to give a channel 50 feet wide on the bottom and depth of 5 feet at mean low water, has been completed. The channel was obstructed by a ledge of rock, and by sand, gravel, and boulders, giving a channel depth of less than 3 feet at low water.

The original estimate for cost of the work was	\$47,000.00
Expenditures to June 30, 1888	37,682.11
Expenditures in last fiscal year	9,027.61
Total	<hr/> 46,709.72

In addition to completion of project, the channel at Alley's Point has been further improved by removing the filling from a land slide, and making excavations to prevent a recurrence.

The river and harbor act of August 11, 1888, required an examination or survey of this river. The preliminary report having indicated that the river is worthy of improvement, the officer in charge of the improvement has been instructed to make a survey and submit a plan of the further improvements considered necessary.

The small balance of available funds will be expended in making the survey.

July 1, 1888, amount available.....	\$317.89
Amount appropriated by act of August 11, 1888.....	9,000.00
	<hr/> 9,317.89
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	9,027.61
July 1, 1889, balance available	<hr/> 290.28

(See Appendix A 20.)

21. *Harbor of Refuge at Little Harbor, New Hampshire.*—The project for this improvement upon the "enlarged plan," as indicated in river and harbor act of August 11, 1888, consists of two small breakwaters at the mouth of the harbor, and of dredging the channel and anchorage to a depth of 12 feet at low water. The object of the improvement is to form a refuge for vessels in the very frequent times when the adverse winds and strong tidal currents are such that they can not get into Portsmouth Harbor. The harbor had a small anchorage, 9

feet deep at low water, but the channel leading to it had an average depth of less than 6 feet. Amount expended to June 30, 1888, \$9,907.76; expended during last fiscal year, \$11,418.23. As a result, a channel of 9 feet depth and 75 wide has been dredged entirely to the anchorage, and several cuts have been made to enlarge the anchorage.

Work is now in progress under a contract for expending available funds in dredging to a depth of 9 feet.

It is proposed to expend funds which may be appropriated in constructing one or both breakwaters, and, subsequently, in dredging to a depth of 12 feet at low water.

July 1, 1888, amount available	\$92.24
Amount appropriated by act of August 11, 1888.....	20,000.00

20,092.24

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$3,893.68
July 1, 1889, outstanding liabilities.....	7,524.55
July 1, 1889, amount covered by existing contracts	7,505.88

18,924.11

July 1, 1889, balance available.....	1,163.13
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{ Amount (estimated) required for completion of existing project	205,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	50,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 21.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examinations of the following localities were made by the local engineer in charge, Lieutenant Colonel Smith, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers, concurring in the conclusions reached in these instances, has given no instructions to make further survey with the view to their improvement:

1. *Harbor and channel at Pembroke, Maine.*—(See Appendix A 22.)
2. *Monhegan Island Harbor, Maine.*—(See Appendix A 23.)
3. *Medomac River, Maine.*—(See Appendix A 24.)
4. *Hampton River, New Hampshire.*—(See Appendix A 25.)

A preliminary examination of *Harrisseecket [Harraseeket] River, Maine*, was made by the local engineer, and reported by him as worthy of improvement, and this conclusion being concurred in by the Chief of Engineers, the result of the preliminary examination containing information sufficient to indicate to Congress the probable cost of the work required, no further report or survey appeared to be necessary. Estimated cost of improvement, \$36,000. (See Appendix A 26.)

It appearing from the report of the preliminary examination made by the local engineer that the following localities are worthy of improvement, and the public necessity therefor being apparent from the facts and reasons reported, which are concurred in by the Chief of Engineers, Lieutenant-Colonel Smith was charged with their survey, the results of which will be submitted when received.

1. *Belfast Harbor, Maine.*
2. *Union River and Union River Bay, Maine.*
3. *St. Croix River, Maine.*

4. *Pleasant River, from Columbia Falls to its mouth, Maine.*
5. *Kennebunk River, Maine.*
6. *Cacheco River, from Dover to its mouth, New Hampshire.*

IMPROVEMENT OF RIVERS AND HARBORS IN MASSACHUSETTS.

Officers in charge, Lieut. Col. G. L. Gillespie, Corps of Engineers, until December 20, 1888, since which date Lieut. Col. S. M. Mausfield, Corps of Engineers.

1. *Newburyport Harbor, Massachusetts.*—The object of the improvement is to create a channel through the outer bar, 1,000 feet wide and with a least depth of 17 feet at mean low water, or 24½ feet at mean high water. The project adopted in 1880, and modified in 1883, is to build two converging rubble-stone jetties, so located as to give a proper direction to the current, and thereby produce and maintain the desired result. The estimated cost of the project was \$375,000, and the amount appropriated to date is \$232,500.

To June 30, 1888, \$207,498.27 had been expended, and the north jetty was 2,675 feet long, of which 1,930 feet are fully completed, and the residue, 745 feet, was a core of stone built up to low water. The south jetty was 1,300 feet long, of which 1,077 feet were fully completed, and the residue, 223 feet, was a core of stone built up to low water.

The Plum Island Dike was 817 feet long, 5½ feet high above mean low water, except near the center, where a weir is left temporarily, 150 feet long, and 2 feet deep at mean low water.

The sand-catch in rear of the south jetty was in two branches, one 480 feet long, and one 572 feet.

All these works were in good order.

During the fiscal year, 5,185 tons of rubble-stone were deposited in the north jetty. It is now 2,675 feet long, of which 2,080 feet are completed, and the residue, 595 feet, is a core of stone built up to low water.

On June 30, 1889, the south jetty, the Plum Island Dike, and the sand-catch remain in the same condition as at the date of the last report.

A survey of the bar was made in June, 1889. It showed that the channel had straightened, but narrowed slightly, and the depth on the crest of the bar was less than last year, owing to the slight spring freshet in the river.

The advantages to be derived from the completion of the project are the deepening and widening of the channel across the bar, thereby affording a harbor of refuge on the inside of Salisbury Point, and also affording easy access at high water to the wharves at Newburyport for vessels drawing 17 feet approximately.

July 1, 1888, amount available.....	\$1. 73
Amount appropriated by act of August 11, 1888.....	25, 000. 00
	<hr/> 25, 001. 73
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$3, 946. 68
July 1, 1889, outstanding liabilities.....	7, 847. 11
July 1, 1889, amount covered by existing contracts.....	9, 485. 55
	<hr/> 21, 279. 34
July 1, 1889, balance available.....	3, 722. 39
	<hr/>
{ Amount (estimated) required for completion of existing project.....	142, 500. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	50, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix B 1.)	

2. *Merrimac River, Massachusetts.*—The object of the improvement is to straighten, deepen, and widen the natural channel of the river from its mouth to the Upper Falls, a distance of $21\frac{1}{2}$ miles.

The channel originally was narrow, crooked, and much obstructed by ledges, bowlders, and shoals; and below Newburyport by ledges, cribs, piers, and wrecks.

At mean low water vessels drawing not to exceed 7 feet could cross the bar and proceed about 6 miles above Newburyport.

The mean rise or fall of the tide at the mouth of the river is $7\frac{1}{2}$ feet, at Haverhill Bridge, 4 feet.

The project originally adopted, in 1870, proposed to remove obstructions from the Upper and Lower Falls, to remove Gangway Rock, to remove the wreck of the schooner *Globe*, and to remove the "Boilers." The cost was estimated at \$69,025. This project was revised and extended in 1874 to include the removal of rocks at Deer Island and Rock Bridges, and at Little Carrier's Shoal, so that the channel should have the following depths at ordinary high-water stages of the river: From the mouth to Deer Island Bridge (5 miles), $16\frac{1}{2}$ feet; from Deer Island Bridge to Haverhill Bridge ($12\frac{1}{2}$ miles) 12 feet; thence to the foot of Mitchell's Falls ($1\frac{1}{2}$ miles), 10 feet; through Mitchell's Falls to the head of the Upper Falls ($2\frac{1}{2}$ miles) not less than $4\frac{1}{2}$ feet, with the mill water at Lawrence running. This revised project was estimated to cost \$147,000.

The total appropriations to date have been \$170,500. The total expenditures to June 30, 1888, were \$170,498.43, and the river channel had been improved in accordance with the modified project, with the exception of the removal of the "Boilers," upon which no work has been done.

No operations were in progress during the year, and the improvement remains in good order.

To complete the improvement so that the same depth of water which has been obtained through Mitchell's Falls can be carried to Lawrence, additional work will be required at the falls above Haverhill, which is estimated to cost \$11,000; and additional improvements could be made in the lower part of the river, which are estimated to cost \$11,500, or a total of \$22,500.

The improved channel is in good order and meets all existing demands of commerce.

No appropriation is recommended for the year ending June 30, 1891.

July 1, 1888, amount available	\$1.57
July 1, 1889, amount expended during fiscal year, exclusive of liabilities, outstanding July 1, 1888	1.57
(See Appendix B 2.)	

3. *Powow River, Massachusetts.*—Powow River is a tributary of the Merrimac River, into which it enters from the north, about $3\frac{1}{2}$ miles above Newburyport. From the mouth, tide water extends 9,600 feet in a narrow crooked channel not navigable at low water.

The project proposed for its improvement is to dredge a channel 9,600 feet long, 60 feet wide, and 12 feet deep, at mean high water, at an estimated cost of \$77,000.

The river and harbor act of August 11, 1888, appropriated \$3,000 for this work, provided a suitable draw was built in the bridge which now crosses the mouth of the river.

Action is in progress by the town authorities having in view compliance with this proviso.

No expenditures were made during the year ending June 30, 1889, and the original condition of the river is unaltered.

To complete the proposed improvement will cost \$74,000, of which amount \$10,000 could be expended during the fiscal year ending June 30, 1891.

Amount appropriated by act of August 11, 1888.....	\$3,000.00
July 1, 1889, balance available.....	3,000.00

{ Amount (estimated) required for completion of existing project.....	74,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B 3.)

4. *Ipswich River, Massachusetts.*—Ipswich River empties into Plum Island Sound about 9 miles south of Newburyport, Mass. It is navigable from its mouth to the wharves at Ipswich, a distance of 3 miles. Before improvement, at low water not to exceed $1\frac{1}{2}$ feet draught could be carried in a narrow channel.

The mean rise or fall of the tide is 8.4 feet.

The object of the improvement is to widen and deepen the natural channel of the river.

The original project was submitted in 1875. It proposed a channel 60 feet wide and 4 feet deep at mean low water, at an estimated cost of \$25,000.

The total amount appropriated for this improvement to date is \$5,000.

The amount expended to June 30, 1888, was \$2,500. At that date a navigable channel existed at least 40 feet wide and 4 feet deep at mean low water.

The expenditures during the fiscal year were \$32.08.

Proposals were invited by public advertisement for the completion of the improvement, and but one bid was received. It was rejected as excessive. The work will be re-advertised.

The condition of the improvement June 30, 1889, is the same as on June 30, 1888. It is believed that the funds available will suffice to complete the present partial project, or all that the present commerce justifies.

The prospective benefits to commerce are increased facilities and safety to navigation.

Amount appropriated by act of August 11, 1888.....	\$2,500.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	32.08
July 1, 1889, balance available	2,467.92

{ Amount (estimated) required for completion of existing project.....	20,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B 4.)

5. *Harbor of Refuge, Sandy Bay, Cape Ann, Massachusetts.*—This bay is situated at the northeastern extremity of Cape Ann, Massachusetts. It is open to the full effect of easterly and northeasterly gales.

The proposed improvement contemplates the construction of a National harbor of refuge of the first class. The anchorage covered by the proposed breakwater will contain 1,377 acres.

No definite project for the masonry construction of the breakwater above the rubble mound has been adopted. To the level of 22 feet be-

low mean low water it will consist of a mound of rubble-stone 40 feet wide on top. The estimated cost of the improvement is \$5,000,000.

The total amount appropriated to date is \$300,000. The expenditures to June 30, 1888, were \$194,125.24.

The condition of the improvement June 30, 1888, was as follows: 242,934 tons of rubble-stone had been deposited, by which 2,200 running feet of the substructure of the breakwater were essentially completed.

During the year ending June 30, 1889, a survey of the breakwater was made and a contract entered into for the delivery of 110,000 tons, more or less, of rubble-stone to be deposited in the breakwater. Under this contract 41,965 tons were delivered during the year.

To complete the project will require an appropriation of \$4,700,000.

During the fiscal year ending June 30, 1891, \$150,000 could be expended to advantage.

The prospective benefits to commerce and navigation by the construction of this harbor of refuge are increased safety to life and property, and a consequent reduction in freights and insurance.

July 1, 1888, amount available.....	\$5,874.76
Amount appropriated by act of August 11, 1888.....	100,000.00
	<hr/> 105,874.76

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$28,740.02
July 1, 1889, outstanding liabilities.....	8,896.52
July 1, 1889, amount covered by existing contracts.....	48,304.85
	<hr/> 85,941.39

July 1, 1889, balance available.....	19,933.37
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{ Amount (estimated) required for completion of existing project.....	4,700,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	150,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B 5.)

6. *Gloucester Harbor, Massachusetts.*—Gloucester Harbor is an important center for the fishing fleet of New England, about 20 miles north of Boston. Its inner harbor was originally obstructed by sunken rocks and shoals, preventing free movement of vessels; and the approaches to the wharves were shallow, varying from 1 to 12 feet. The outer harbor was open to all southerly winds.

The first project submitted in compliance with the act of July 11, 1870, proposed to clear the harbor of sunken rocks, and to build a stone breakwater from Eastern Point to Round Rock Shoal. The operations in execution of this general project under the acts of July 11, 1870, and June 10, 1872, have been confined solely to the removal of isolated sunken rocks specially obstructive to the navigation of the inner harbor.

The act of June 10, 1872, appropriated \$10,000, which sum was applied to the removal of Clam Rock, Pinnacle Rock, rock off J. Friend's Wharf, rock off Pew's Wharf, and a portion of Babson's Ledge.

The act of August 5, 1886, appropriated \$5,000 for a survey of the harbor, and for continuing work on Babson's Ledge.

The survey was completed in December, 1886, and a report and general project based on this survey was published in the report of the Chief of Engineers for 1887, page 500.

The revised project proposed to remove from the inner harbor 101½ cubic yards of rock known to exist, and 216,000 cubic yards, scow measurement, of material, at an estimated cost of \$65,000; and to construct

the breakwater that extends from Eastern Point to Round Rock Shoal, recommended in the project of 1884, at an estimated cost of \$752,000.

The total appropriations to date have been \$25,000. The amount expended to June 30, 1888, was \$15,000.

On June 30, 1888, the condition of the improvement was as follows:

Clam Rock, Pinnacle Rock, rock off J. Friend's Wharf, and rock off Pew's Wharf had been reduced to the level of the surrounding bottom, and Babson's Ledge to 14 feet at mean low water.

During the fiscal year ending June 30, 1889, 17,596 cubic yards were dredged from Harbor Cove, and 170 cubic yards of ledge and bowlders were removed from the approaches to the wharves between Harbor Cove and Pew's Wharf. The dredging in Harbor Cove made two channels of approach to the wharves, each 40 feet wide and 10 feet deep; the eastern one 550 feet long, the western 1,000 feet long.

To complete the proposed dredging will cost \$55,000; to complete the proposed breakwater, \$752,000; total, \$807,000. Of this amount, \$25,000 could be expended to advantage during the fiscal year ending June 30, 1891.

Amount appropriated by act of August 11, 1888	\$10, 000. 00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$9, 326. 46
July 1, 1889, outstanding liabilities.....	240. 00
	<hr/> 9, 566. 46
July 1, 1889, balance available.....	<hr/> 433. 54

{ Amount (estimated) required for completion of existing project.....	55, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	25, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B 6.)

7. *Manchester Harbor, Massachusetts.*—Manchester Harbor is situated about 5½ miles northeast from the entrance of Salem Harbor, Massachusetts.

Its outer roadstead contains 300 acres approximately, with 5 fathoms of water. Its entrance channel is 100 feet wide and 6½ feet deep at mean low water up to Proctor's Point; it then shoals rapidly to a depth of 1½ feet at the "Narrows," 1,400 feet from Proctor's Point; and for a further distance of 2,500 feet to the town wharves no low-water channel exists.

The project for its improvement is based on the survey provided for in the act of August 5, 1886. It proposes to dredge a channel from Proctor's Point to the town wharves, 4,000 feet long, 60 feet wide, and 4 feet deep at mean low water, at an estimated cost of \$14,000.

The act of August 11, 1888, appropriated \$2,500 for this work. It was proposed to expend this amount in partial execution of the project in the removal of a ledge near Proctor's Point, but after proposals had been advertised for and opened November 2, 1888, it was decided to retain the amount available in the Treasury until further funds are provided.

No other operations have been in progress, and the original condition of the harbor is unchanged.

To complete the project will require an appropriation of \$11,800.

Amount appropriated by act of August 11, 1888.....	\$2, 500. 00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	103. 07
July 1, 1889, balance available.....	<hr/> 2, 396. 93

{ Amount (estimated) required for completion of existing project.....	\$11,800.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891.....	5,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B 7.)

8. *Lynn Harbor, Massachusetts.*—The object of this improvement is to obtain a more direct, wider, and deeper channel of approach to the city wharves. The original channels were narrow and crooked, and had but 6 feet depth at mean low water, and the greater part of the harbor was bare at low water.

The project was adopted in 1884. It proposed a channel 200 feet wide and 10 feet deep at mean low water, through the outer and inner bars. The outer channel is 3,610 feet long; the inner one 6,450 feet. It is supposed that the inner channel will need occasional dredging. To aid in keeping the outer channel open a training wall is proposed, if experience shall show it to be necessary.

On September, 1888, the project was modified by extending the inner channel 400 feet inside the harbor line, and making at its inner end an anchorage basin 500 by 300 feet in area, 10 feet deep at mean low water.

The cost of the project, as revised in 1888, was \$182,000. The total appropriations to date are \$76,000. The expenditures to June 30, 1888, were \$65,962.60.

On that date the outer channel had been completed 3,610 feet long, 200 feet wide; the inner channel was 6,450 feet long, 150 feet wide; both were 10 feet deep at mean low water.

A contract was entered into November 23, 1888, for the expenditure of \$10,000 made available for this improvement by the river and harbor act of August 11, 1888. This contract expires December 31, 1889. No operations were in progress under it during the fiscal year ending June 30, 1889. A survey of the western channel is in progress to determine its condition and what part of the funds available shall be expended for this channel.

The condition of the improvement is the same as at date of last report. To complete the improvement according to project heretofore approved will cost \$81,000.

During the fiscal year ending June 30, 1891, \$25,000 could be expended to advantage in widening the inner channel and the extension to the inner basin. The prospective benefits to commerce are increased facilities and safety to navigation.

July 1, 1888, amount available.....	\$37.40
Amount appropriated by act of August 11, 1888.....	10,000.00
	<hr/> 10,037.40

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$53.32
July 1, 1889, outstanding liabilities.....	228.50
July 1, 1889, amount covered by existing contracts.....	8,120.00
	<hr/> 8,401.82

July 1, 1889, balance available.....	1,635.58
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{ Amount (estimated) required for completion of existing project.....	81,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891.....	25,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B 8.)

9. *Winthrop Harbor, Massachusetts.*—Winthrop Harbor is situated in the northeastern part of Boston Harbor. It contains 350 acres, approx-

imately, all of which is essentially dry at low tide. The mean range of tides is 9.4 feet.

The original project for its improvement was based on the survey provided for in the act of August 5, 1886. It proposes to dredge a straight channel, 3,900 feet long, 50 feet wide, 6 feet deep at mean low water, from the "Back" channel of Boston Harbor to Rice's Wharf.

The river and harbor act of August 11, 1888, appropriated \$1,000 for this harbor. This sum was insufficient to commence any operations that would be of benefit to commerce, and it has been retained in the Treasury.

No operations have been in progress or expenditures made during the fiscal year ending June 30, 1889.

The original condition of the harbor is unchanged.

To complete the improvement will require an appropriation of \$16,600.

Amount appropriated by act of August 11, 1888.....	\$1,000.00
July 1, 1889, balance available.....	1,000.00

{ Amount (estimated) required for completion of existing project.....	\$16,600.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	5,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B 9.)

10. *Boston Harbor, Massachusetts.*—The object of this improvement is, first, to preserve the harbor by protecting the islands and headlands; and second, to improve it by widening, straightening, and deepening the channels.

The projects adopted for this purpose since 1866 have been mainly in accordance with the recommendations of the United States commissioners, whose labors terminated during that year.

The works of preservation consist of sea-walls, aprons, jetties, etc., which protect the shores of the islands and headlands, prevent additional wash into the channels, control the tidal scour, and preserve the full height of anchorage shelter for vessels in the roadsteads.

Such have been built or repaired at Point Allerton and the islands of Great Brewster, Lovell, Gallop's, Long, Deer, Rainsford, George's, and Castle.

The works of improvement have been by dredging and blasting, by which means many dangerous rocks and shoals have been removed and the main ship-channel enlarged from 100 feet wide and 18 feet deep at mean low water so that it is now at least 600 feet wide and 23 feet deep at mean low water.

The following tributary channels have also been improved:

1. *Charles River.*—The natural channel of this river has been widened, straightened, and deepened, so that from its mouth up to Western Avenue Bridge, a distance of $4\frac{1}{2}$ miles, the channel has a width of 200 feet, and a depth of 7 feet at mean low water; thence to Arsenal Street Bridge, $2\frac{1}{4}$ miles, the channel has a least width of 80 feet, and a least depth of 6 feet.

2. *Fort Point Channel.*—This important branch of the main ship-channel originally had a least depth of 12 feet at its entrance, and the channel was narrow and crooked. It has been widened to 175 feet and deepened to 23 feet at mean low water from its mouth to Congress Street Bridge, a distance of 1,900 feet.

3. *Hingham Harbor.*—(See separate report.)

4. *Nantasket Beach Channel*.—The project adopted in 1880 was to widen and deepen the channel so that it would be at least 100 feet wide and 9½ feet deep at mean low water. The project was completed in 1881 and 1883.

5. *Channel between Nia's Mate and Long Island*.—This channel had originally 4½ feet depth at mean low water. A cut has been made through the bar, 200 feet wide, 550 feet long, and 12 feet deep at mean low water.

This improved channel has proved to be of great convenience to the local commerce, and should be widened to 300 feet and deepened to 15 feet, mean low water, and its axis slightly changed.

6. *Broad Sound*.—An obstruction called "Barrel Rock" was removed in 1869.

The total appropriations to date for this harbor have been, since 1867, \$1,788,750. The expenditures to June 30, 1888, were \$1,654,020.74 (inclusive of outstanding liabilities).

During the fiscal year ending June 30, 1889, 146,556 cubic yards were dredged from the main ship-channel at the Upper and Lower Middle, and 375 cubic yards of ledges were removed from it at the Lower Middle.

The channel is now 750 feet wide at the Upper Middle and 1,000 feet wide at the Lower Middle, 23 feet deep at mean low water.

The extension of the sea-wall at Gallop's Island was commenced and about 75 feet of the work completed during the fiscal year.

The sea-wall at George's Island was repaired at an expense of \$300. A general survey of the outer harbor was made.

The several works of improvement are in good order and show no serious deterioration.

The existing works of preservation are generally in good order, but some of them require repairs and extensions.

July 1, 1888, amount available.....	\$3, 129. 26
Amount appropriated by act of August 11, 1888.....	125, 000. 00

128, 129. 26

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$70, 438. 54
July 1, 1889, outstanding liabilities.....	6, 984. 30
July 1, 1889, amount covered by existing contracts.....	8, 205. 40
	<hr/> 85, 628. 24

July 1, 1889, balance available	42, 501. 02
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{ Amount (estimated) required for completion of existing project.....	325, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	200, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B 10.)

11. *Hingham Harbor, Massachusetts*.—The object of the work is to widen and deepen the natural channel, which was 30 feet wide and 4 feet deep, so that it will be 100 feet wide and 10 feet deep at mean low water.

The project was originally proposed in 1874 and was modified in 1885. The original project was estimated to cost \$11,000. The project of 1885 was to cost an additional sum of \$18,750.

The total amount appropriated to date has been \$21,000. The amount expended to June 30, 1888, was \$16,000.

The condition of the work on June 30, 1888, was as follows :

The channel was 100 feet wide and 8 feet deep throughout, and at the ledge where operations have been in progress under the modified

project the channel was 10 feet deep at mean low water in a cut through the ledge 50 feet wide.

During the year ending June 30, 1889, a contract was entered into with Mr. G. W. Townsend to remove 200 cubic yards of ledge from the channel. This contract expires December 31, 1889. Operations under it were commenced in May, 1889, and are still in progress.

To complete the present project will require an appropriation of \$8,000, all of which could be expended during the fiscal year ending June 30, 1891.

The prospective benefits to commerce are increased facilities and safety to navigation.

Amount appropriated by act of August 11, 1888	\$5,000. 00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$142. 68
July 1, 1889, outstanding liabilities	2,155. 00
July 1, 1889, amount covered by existing contracts	2,000. 00
	<hr/> 4,297. 68
July 1, 1889, balance available	<hr/> 702. 32

{ Amount (estimated) required for completion of existing project	8,000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	8,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B 11.)

12. *Scituate Harbor, Massachusetts.*—This harbor is on the west shore of Massachusetts Bay, about 14 miles south of Boston Light.

The object of the improvement is to create a harbor of refuge for vessels bound to Boston from the eastward, which are too far south of their true course to clear the dangerous ledges near Minot's Ledge Light.

Originally the harbor had a low-water area of about 57 acres, more than 6 acres of which had a depth of at least 3 feet at mean low water. It was entirely open to the action of easterly gales, and its entrance was obstructed by sunken boulders.

The project adopted in 1880, is to build two breakwaters, one from "Cedar Point" on the north side of the entrance, and the other from the "First Cliff" on the south side; and to dredge the area inclosed and in front of the entrance. The estimated cost of the improvement is \$290,000.

The total appropriations to date are \$52,500. The expenditures to June 30, 1888, were \$47,500.

The condition of the improvement June 30, 1888, was as follows:

The north breakwater was essentially completed. Nothing had been done on the south breakwater. The entrance channel was 1,600 feet long, 100 feet wide, and 5 feet deep at mean low water. The anchorage basin was 350 by 450 feet in area, 7 feet deep at mean low water.

The river and harbor act of August 11, 1888, provided \$5,000 for this improvement, and a contract was executed November 26, 1888, to dredge 9,000 cubic yards from a channel leading from the anchorage basin to the town wharf, 2,100 feet long, 25 feet wide, and 1 foot deep at mean low water. No operations have been in progress under this contract during the fiscal year, and the condition of the improvement remains the same as on June 30, 1888.

To complete the improvement will require an appropriation of \$237,500.

During the year ending June 30, 1891, \$25,000 could be expended to advantage, in commencing the south breakwater, and in enlarging the anchorage basin and the channel to the town wharves.

The prospective benefits to commerce by the completion of this improvement are the creation of an additional harbor of refuge on this much frequented dangerous coast.

Amount appropriated by act of August 11, 1888.....	\$5,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$46.08
July 1, 1889, amount covered by existing contracts.....	4,050.00
	<hr/> 4,096.08
July 1, 1889, balance available.....	<hr/> 903.92

{ Amount (estimated) required for completion of existing project.....	237,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	25,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B 12.)

13. *Plymouth Harbor, Massachusetts.*—Plymouth Harbor is 30 miles south of Boston. The object of its improvement is to perpetuate the harbor by the preservation of Long Beach, which forms it; and to deepen and widen the channels of approach to an enlarged anchorage basin in front of the town wharves.

The various devices employed for the preservation of Long Beach are described in the Annual Report of the Chief of Engineers for the year 1877.

The original project for improvement was adopted in 1875, and modified in 1877 and 1884. The modified project proposed an improved channel 2,286 feet long, 150 feet wide, and 9 feet deep at mean low water.

From 1866 to date, \$120,800 have been appropriated for this harbor.

The expenditures to June 30, 1888, were, for beach protection, \$72,587.56; for dredging, etc., \$42,212.44; total, \$114,800.

The channel was 115 feet wide, 9 feet deep at mean low water; the basin was 800 feet long, 9 feet deep for 90 feet of its width nearest the town wharves, and averaged 5 feet deep for the remainder of its width.

During the fiscal year a contract was entered into to dredge 13,000 cubic yards from the basin; the contract expires December 31, 1889. No operations under it have been in progress during the fiscal year.

Four breaches in Long Beach, aggregating 370 feet in length, were closed with bulkheads of plank by hired labor, at a cost of \$444.17.

The condition of the improvement on June 30, 1889, is essentially the same as at the close of the last year.

To complete the present project, and to provide funds for necessary and probable repairs to Long Beach, will require an appropriation of \$17,500.

The prospective benefits to commerce are increased facilities and safety to navigation.

Amount appropriated by act of August 11, 1888.....	\$6,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$502.75
July 1, 1889, amount covered by existing contracts.....	3,883.75
	<hr/> 4,386.50
July 1, 1889, balance available.....	<hr/> 1,613.50

{ Amount (estimated) required for completion of existing project.....	17,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B 13.)

14. *Wellfleet Harbor, Massachusetts.*—Wellfleet Harbor is 12 miles southeast of Provincetown, on Cape Cod Bay.

The object of its improvement is to provide a navigable channel from the inner anchorage, the "Deep Hole," to the town wharves.

The project originally proposed in 1871 was to dredge two channels of approach to the town wharves and to remove several dangerous sunken rocks.

The removal of the sunken rocks was effected by an appropriation provided by the act of June 10, 1872.

The present project is to dredge a channel from the "Deep Hole" to the town wharves, 4,200 feet long, 100 feet wide, and 6 feet deep at mean low water.

To date, \$12,000 have been appropriated for this improvement. The expenditures to June 30, 1888, were \$5,000, by which 204 cubic yards of sunken rocks had been removed. No low-water channel existed to the wharves.

During the fiscal year ending June 30, 1889, a contract was entered into to dredge a channel 2,500 feet long, 25 feet wide, and 4 feet deep, extending from the "Deep Hole" to the town wharves. No operations have been in progress under this contract, and the condition of the improvement remains the same as on June 30, 1888.

To complete the improvement will require, at the present prices for dredging, an appropriation of \$26,000.

Amount appropriated by act of August 11, 1888.....	\$7,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$43.54
July 1, 1889, amount covered by existing contracts.....	6,210.00
	<hr/> 6,253.54
July 1, 1889, balance available.....	<hr/> 746.46

{ Amount (estimated) required for completion of existing project.....	26,000.00
{ Amount that can be profitable expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B 14.)

15. *Provincetown Harbor, Massachusetts.*—Provincetown Harbor is situated at the extremity of Cape Cod, about 40 miles southeast from Boston Light. It is one of the most valuable harbors of refuge on the Atlantic coast. The entire commerce of New England and a very large local fishing interest are directly benefited by its maintenance, which depends entirely on the preservation of the sandy beaches which inclose it.

Since 1826 the project has been a general one, and provides for the preservation of the harbor by building dikes, bulk-heads, and sand-catches, and extensive planting of beach-grass to repair and prevent storm damages to the beaches. From the nature of the work it can at no time be considered completed. A special dike across House Point Island Flats, to be built contingently, was recommended in the annual report for 1886.

A plan of the harbor was published in the Annual Report of the Chief of Engineers for 1886.

The total appropriations or allotments for this work up to date have been \$146,478.44.

The amount expended to June 30, 1888, was \$139,328.09, and the several works of preservation were in good order, although Long Point Breakwater needed additions.

During the fiscal year 769 tons of stone and 135 cords of brush were added to the Long Point breakwater, completing 300 feet of its length.

At the date of this report all the works of preservation are in good order, but the central part of Long Point needs a new bulk-head 2,000 feet long, to cost \$6,000.

During the fiscal year ending June 30, 1891, \$7,500 could be expended in the repair of probable storm damage, and in building a new bulk-head at Long Point.

The prospective benefit to commerce is the preservation of an important harbor of refuge.

July 1, 1888, amount available.....	\$150.35
Amount appropriated by act of August 11, 1888.....	7,000.00

7,150.35

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$1,715.18
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July 1, 1889, outstanding liabilities.....	654.92
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July 1, 1889, amount covered by existing contracts.....	788.78
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3,158.88

July 1, 1889, balance available.....	3,991.47
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{ Amount (estimated) required for completion of existing project.....	7,500.00
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{ Amount that can be profitably expended in fiscal year ending June 30, 1891	7,500.00
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{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
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(See Appendix B 15.)

16. *Removal of sunken vessels or craft obstructing or endangering navigation.*—The wrecks of the schooners *Mary* and *Goldsmith Maid* lying in Boston Harbor, Massachusetts, were, in accordance with the act of 1880, examined, advertised, and removed by contract. The *Goldsmith Maid* was sunk in deep water outside the harbor; the wreck of the *Mary* was advertised and sold.

The cost of removal was \$1,925. The proceeds of the sale, \$251.

(See Appendix B 16.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examinations of the following localities were made by the local engineer in charge, Lieutenant-Colonel Gillespie, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers concurring in the conclusions reached in these instances, has given no instructions to make further survey with the view to their improvement:

1. *Malden River, Massachusetts, as to straightening, widening, and deepening the channel.*—(See Appendix B 17.)

2. *Cohasset Harbor, Massachusetts.*—(See Appendix B 18.)

3. *Goose Point Channel, Plymouth Harbor, Massachusetts, to public wharf at Kingston.*—(See Appendix B 19.)

At the following localities, reported by the local engineer as worthy of improvement, and this conclusion being concurred in by the Chief of Engineers, the result of the preliminary examination containing information sufficient to indicate to Congress the probable cost of the work required, no further report or survey appeared to be necessary:

1. *Weir River, Massachusetts.*—Estimated cost of improvement, \$7,000.—(See Appendix B 20.)

2. *Stage Harbor at Chatham, Massachusetts.*—Estimated cost of improvement, \$15,000.—(See Appendix B 21.)

It appearing from the report of the preliminary examination made by the local engineer that the following localities are worthy of improvement, and the public necessity therefor being apparent from the facts and reasons reported, which are concurred in by the Chief of Engineers, Lieutenant-Colonel Mansfield was charged with their survey, the results of which will be submitted when received:

1. *Weymouth River, Massachusetts.*
2. *Salem Harbor, including South River, Massachusetts.*
3. *Beverly Harbor, Massachusetts.*
4. *Crane and Waters Rivers of Essex Branch, Massachusetts. (For Crane River only.)*

IMPROVEMENT OF HARBORS AND RIVERS ON THE SOUTHERN COAST OF MASSACHUSETTS AND IN RHODE ISLAND AND CONNECTICUT.

Officer in charge, Maj. W. R. Livermore, Corps of Engineers, with Capt. T. L. Casey, Corps of Engineers, under his immediate orders until November 21, 1888. Division engineer, Col. H. L. Abbot, Corps of Engineers.

1. *Harbor of Refuge at Hyannis, Massachusetts.*—This harbor, before improvement, was an open roadstead exposed to southerly storms. In the years 1827–1838 a breakwater of riprap granite 1,170 feet long was constructed, covering an anchorage of about 175 acres, the entrance to which has a depth of about 15½ feet. Between the years 1852 and 1882 extensive repairs were made in increasing the width of its base and the size of the stone forming its sides and top.

The depth of water immediately inside the breakwater being insufficient for many vessels that seek the harbor for refuge, the present project for the improvement of the harbor contemplates dredging the area protected by the breakwater to a depth of 15½ feet at mean low water.

The amount expended on this work up to June 30, 1888, was \$127,532.29. The breakwater had been completed according to the original project and subsequent plans for strengthening it, and the 15½-foot anchorage area had been increased by about 6½ acres. Nothing has been done during the past fiscal year owing to the impossibility of obtaining satisfactory prices for the work.

The amount available and the appropriation of \$20,000 asked for is to be applied to extending the 15½-foot anchorage area.

July 1, 1888, amount available*	\$5,825.29
Amount appropriated by act of August 11, 1888.....	10,000.00
	<hr/> 15,825.29

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$1,539.33
July 1, 1889, outstanding liabilities.....	324.19
	<hr/> 1,863.52

July 1, 1889, balance available	<hr/> 13,961.77
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{ Amount (estimated) required for completion of existing project.....	25,662.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	20,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C 1.)

* Includes \$5,804.47 from lapsed contract.

2. *Harbor of Refuge at Nantucket, Massachusetts.*—This harbor is the only one between the harbors of Martha's Vineyard (Vineyard Haven and Edgartown) and Provincetown, a distance of about 100 miles, except the small harbor of Hyannis, on the north side of Nantucket Sound. It has deep water inside, and the object of improvement is to make it a harbor of refuge for vessels plying between ports north and south of Cape Cod.

Before the commencement of the present work there was a shoal about $1\frac{1}{2}$ miles in width outside the entrance, through which the channel or line of best water was only about 6 feet deep, and very crooked and subject to changes in location.

The present approved project is to construct jetties of riprap stone, projecting from either side of the present entrance to the harbor, for the purpose of concentrating the strength of the tidal currents and excavating a channel of 15 feet depth by scour, and at the places where the full depth required will not be reached by this means to complete the work by dredging.

The amount expended on this project up to the close of the fiscal year ending June 30, 1888, was \$118,458.45, and the result was the construction of the west jetty to a point 3,955 feet from the shore, and the east jetty to a distance of 385 feet from the initial point on the shore, and partially for an additional distance of 200 feet.

The construction of the east jetty was continued during the year, and 673 tons of stone was placed in the work.

The balance available and the amount asked for, \$50,000, is to be applied to the further extension of the east jetty.

July 1, 1888, amount available*	\$6,541.55
Amount appropriated by act of August 11, 1888.	20,000.00

	26,541.55
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$2,772.32
July 1, 1889, outstanding liabilities	1,788.20
July 1, 1889, amount covered by existing contracts.	18,784.80
	23,345.32

July 1, 1889, balance available	3,196.43
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{ Amount (estimated) required for completion of existing project	230,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	50,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C 2.)

3. *Harbor at Vineyard Haven, Massachusetts.*—The object of the improvement is to stop the wearing away of the points of land at the entrance to the harbor known as East Chop and West Chop. As preliminary to the adoption of a general plan of improvement, a portion of the funds available will be devoted to the construction of a series of experimental jetties and other works, which will serve as an immediate protection to the Chops and at the same time will furnish a basis for determining the character and extent of the permanent works required. Operations were commenced in June last, and were in progress at the end of the fiscal year.

The appropriation asked for will be applied to continuing the improvement.

* From lapsed contract.

Amount appropriated by act of August 11, 1888	\$25,000.00
July 1, 1880, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$2,737.73
July 1, 1889, outstanding liabilities	1,184.99
	<hr/> 3,922.72
July 1, 1889, balance available	<hr/> 21,077.28

{ Amount (estimated) required for completion of existing project	35,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	35,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C 3.)

4. *Wareham Harbor, Massachusetts.*—The object of the improvement is to deepen and widen the channel leading from Buzzard's Bay to Wareham. The commerce of Wareham is carried on in sailing vessels, and the channel is to be made a beating channel for such vessels. Another object of the improvement is the raising of Long Beach.

Before improvement the ruling depth in the harbor was about 7 feet at mean low water in a narrow and very crooked channel. Long Beach, a narrow sand spit at the mouth of the harbor, was washed and abraded by the waves and currents at high water, and the material was carried into and shoaled the channel inside.

The original approved project of 1871, for the improvement and its subsequent modifications, provides for a channel 250 feet wide and 10 feet deep at mean low water from Barney's Point down to the entrance to the harbor. Above Barney's Point the width of the channel is to be 350 feet, with the same depth—10 feet—as below that point. The plan includes also the raising and strengthening of Long Beach, of which a large portion was submerged at low water, to carry it above the storm waves and currents and to hold it there, in order to prevent the filling of the improved channel above, by material abraded from the beach.

The total amount expended on the improvement up to the close of the fiscal year ending June 30, 1888, including outstanding liabilities at that date, was \$71,520.64, and the result was that the channel in the upper part of the harbor in front of the wharves was carried to its full width and completed, and the eastern half of the second and third reaches below the wharves, and about two-thirds of the eastern half of the fourth reach, which extends to Barney's Point, were deepened to 10 feet at mean low water. The channel for about one-half its width from Barney's Point to Wareham has been deepened to 10 feet. Long Beach has been raised above high water storm-tides, so that the wash of sand into the improved channel inside the beach has been stopped.

The ruling depth of the approaches to Wareham has been increased from 7 to 9 feet, and the channel greatly widened in all the reaches. Vessels of larger draught can be carried to Wareham than formerly. The increase in width of the harbor is a great help to all vessels in beating in and out of the harbor.

Nothing has been done during the past fiscal year owing to the impossibility of obtaining satisfactory prices for the work.

The balance on hand July 1, 1889, and the appropriation asked for will be applied towards the completion of the channel from the deep water above Long Beach to Wareham, and the further building up of Long Beach,

July 1, 1888, amount available	\$8, 479. 46
Amount appropriated by act of August 11, 1888	4, 000. 00
	<hr/> 12, 479. 46

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$1, 248. 22
July 1, 1889, outstanding liabilities	278. 34
	<hr/> 1, 526. 56

July 1, 1889, balance available	10, 952. 90
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{ Amount (estimated) required for completion of existing project	12, 236. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	12, 200. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C 4.)

5. *New Bedford Harbor, Massachusetts.*—Before improvement the channel had a depth of about 12½ feet at mean low water. The original project for its improvement as modified in 1877 provided for a channel 300 feet wide and 15 feet deep at mean low water from the deep water just above Palmer's Island to the wharves at New Bedford. This project was completed in 1877 at a cost of \$20,000.

The object of the present improvement is to provide a channel 200 feet wide and 18 feet deep at mean low water.

Nothing has been done during the past fiscal year owing to the impossibility of obtaining satisfactory prices for the work.

The amount on hand July 1, 1889, and the appropriation asked for will be applied to continuing the improvement.

Amount appropriated by act of August 11, 1888	\$10, 000. 00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$814. 33
July 1, 1889, outstanding liabilities	176. 67
	<hr/> 991. 00

July 1, 1889, balance available	9, 009. 00
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{ Amount (estimated) required for completion of existing project	25, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	20, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C 5.)

6. *Taunton River, Massachusetts.*—The object of the improvement is to deepen and widen the channel leading to the city of Taunton, at the head of navigation, so that vessels of 11 feet draught can reach the city at high water.

In its original condition the channel was narrow and obstructed by boulders, and from Berkley Bridge to Taunton the depth was not, in places, more than 5 feet at mean high water. A vessel of 30 tons burden was as large as could go up to Taunton.

The approved project of 1871 and its subsequent modifications provide for a channel 60 feet wide and 11 feet deep from Weir Bridge to the ship-yard, a channel 80 feet wide (100 feet at the bends) and 11 feet deep from the ship-yard down to and through the Needles and Briggs's Shoal; thence to Berkley Bridge a channel of the same width and 12 feet deep, and from Berkley Bridge to the deep water at Dighton the channel was to be 100 feet wide and 12 feet deep. The depths are estimated from high water. The ledge which crossed the bottom of the river at Peter's Point, and the numerous boulders which lay on the

* From lapse of contract.

bottom and sides of the channel from Taunton to Dighton, were to be removed. The amount expended on the improvement of the river up to the close of the fiscal year ending June 30, 1888, was \$156,935.94.

With the exception that but 40 feet of the 60 feet of width could be dredged between the bridge at Weir and the ship-yard, on account of interfering with private property, and that on account of the hardness and depth of material at the sides the 80-foot channel was not in all cases dredged to its full width, the channel down to Berkley Bridge had been completed. The channel as proposed between Berkley Bridge and Dighton had been completed—with the exception of removing a small amount of ledge rock uncovered in dredging below Peter's Point—and had been cleared of bowlders from Taunton down to Berkley Bridge. The work of removal of the ledge at Peter's Point had been completed. The material blasted in the channel had been dredged and deposited in the form of a half-tide dam running from Reuben's Island to the west shore of the river, with the view of accelerating the current in the dredged channel off and above Dighton, and preventing deposits in this part of the channel. Vessels of 11 feet draught can now reach Taunton, at the head of navigation.

No work was done during the last fiscal year.

There remains to complete the existing project, widening and deepening at a few points above the bridge and the removal of the small amount of ledge rock above referred to. A map of a survey of parts of Taunton River, with report thereon and project for further improvement, were submitted to Congress January 10, 1888, and printed as House Ex. Doc. No. 86, Fiftieth Congress, first session.

The estimated cost of this additional improvement is \$14,051.

July 1, 1888, amount available.....	\$64.06
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	31.78
July 1, 1889, balance available.....	32.28

{ Amount (estimated) required for completion of existing project.....	14,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	14,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C 6.)

7. *Warren River, Rhode Island.*—Warren River is an arm of Narragansett Bay north of the harbor of Bristol. The obstructions to navigation were a rocky reef below Little Island and a submerged bowlder near mid-channel opposite the lower wharves of the town of Warren. The approved project provided for the removal of these obstructions as far as could be done with an expenditure of \$5,000.

The submerged bowlder was removed and an area of about 1.8 acres extending 550 feet along the narrowest part of the channel was cleared of the projecting points of ledge and bowlders between the months of August and November, 1887.

This completed the improvement as far as projected.

July 1, 1888, amount available.....	\$270.11
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$128.30
July 1, 1889, outstanding liabilities.....	22.03
	150.33
July 1, 1889, balance available.....	119.78

(See Appendix C 7.)

8. *Pawtucket River, Rhode Island.*—Before improvement the channel in the river had a ruling depth of about 5 feet at mean low water.

The project for its improvement, as modified in 1883, provides for the excavation by dredging of a channel 100 feet wide and 12 feet deep at mean low water from the deep water above Red Bridge to the ledge opposite Grant & Company's wharf at Pawtucket; thence the deepening by blasting of a channel through the ledge to Pawtucket Bridge of the same depth and 40 feet wide.

The amount expended to June 30, 1888, was \$131,129.99. The channel had been excavated under the original project to a width of 75 feet and a ruling depth of 7 feet at mean low water, and under the project as modified in 1883 a new channel 12 feet deep and 100 feet wide, with wide enlargements at the bends, had been carried from its mouth at the deep water just above Red Bridge, a distance of about 12,740 feet.

There is now a channel 100 feet wide and 12 feet deep at mean low water from the deep water above Red Bridge to within $1\frac{1}{4}$ miles of the head of navigation.

This completed portion of the channel is already a great benefit to the commerce of the river; a ruling depth of about 6 feet can be carried from the upper end of our present work to Pawtucket.

Nothing has been done during the past fiscal year, owing to the impossibility of obtaining satisfactory prices for the work.

The work yet to be done is to excavate by dredging the channel 12 feet deep and 100 feet wide from its present end to a point opposite Grant & Company's wharf, and from thence to Pawtucket Bridge to deepen the channel through the ledge to the same depth with a width of 40 feet.

With the balance available and the \$50,000 asked for it is proposed to extend this channel further up the river.

July 1, 1888, amount available.....	\$875. 97
Amount appropriated by act of August 11, 1888.....	35,000. 00

35, 875. 97

July 1, 1889, amount expended during fiscal year exclusive of liabilities outstanding July 1, 1888.....	\$3,204. 13
July 1, 1889, outstanding liabilities.....	171. 71

3, 375. 84

July 1, 1889, balance available.....	32,500. 13
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{ Amount (estimated) required for completion of existing project.....	367,478. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	50,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C 8.)

9. *Providence River and Narragansett Bay, Rhode Island.*—The object of this improvement is to furnish a wide and deep channel for foreign and coastwise commerce from the ocean to Providence.

Before the improvement of the river was commenced in 1853 many shoals obstructed navigation, and at one point in the channel, a place called "The Crook," the available low-water depth was but $4\frac{1}{2}$ feet. There was expended between 1852 and the 30th June, 1882, \$290,459.34 in deepening the channel, first to 9 feet, then to 12 feet, then to 14 feet, and again to 23 feet, as the increasing sizes of vessels and the growing commerce of Providence demanded. Bulkhead Rock was also removed during this period to a depth of 20 feet below mean low water.

The approved project of 1878, modified in 1882, under which the work is now in progress, provides for a channel 25 feet deep and 300 feet wide, suitable for large ocean vessels, extending from Fox Point, in the city of Providence, to the deep water of Narragansett Bay, and for an anchorage basin between Fox and Field's points, 300 feet wide, at a depth of 25 feet; 600 feet wide at a depth of 20 feet; 725 feet wide, at a depth of 18 feet; 940 feet wide, at a depth of 12 feet; 1,060 feet wide, at a depth of 6 feet.

The amount expended on the present project up to the close of the fiscal year ending June 30, 1888, was \$242,599.60. At that date the excavation of the anchorage basin above Field's Point had been completed, and of the same areas in the Sassafras Point and the Field's Point reaches, about one-fourth and one-half, respectively, had been done. Bulkhead Rock had been removed, and the 25-foot channel, 300 feet wide, from Providence to the deep water of Narragansett Bay, had been completed.

Nothing was done during the past fiscal year, owing to the impossibility of obtaining satisfactory prices for the work.

There is required for the completion of the existing project the excavation of the remainder of the anchorage basin between Fox and Field's points.

With the amount available and the \$100,000 asked for it is proposed to continue the excavation of the anchorage area.

July 1, 1888, amount available.....	\$1,001. 03
Amount appropriated by act of August 11, 1888.....	40,000. 00

41,001. 03

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$4,235. 35
July 1, 1889, outstanding liabilities.....	48. 41
	<hr/> 4,283. 76

July 1, 1889, balance available.....	36,717. 27
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{ Amount (estimated) required for completion of existing project.....	165,000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	100,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C 9.)

10. *Removal of Green Jacket Shoal, Providence River, Rhode Island.*—This shoal is in that part of Providence River which constitutes the harbor of Providence. It lies off the wharves on the south front of the city, and occupies a part of the harbor that is required for anchorage purposes, covering an area of about 18 acres between the 15-foot curves.

The adopted project is the removal of the entire shoal to a depth of 25 feet at mean low water, limiting the work by lines drawn 200 feet from the harbor lines.

The amount expended, including outstanding liabilities, to June 30, 1888, was \$25,155.60, and the result was the excavation of an area of about 9½ acres on the western side of the shoal to a depth of 25 feet at mean low water, making an important addition to the anchorage facilities of Providence Harbor.

Nothing was done during the past fiscal year, owing to the impossibility of obtaining satisfactory prices for the work.

With the amount available and that asked for, it is proposed to continue the removal of the shoal as far as possible.

July 1, 1888, amount available.....	\$1,094.40
Amount appropriated by act of August 11, 1888.....	28,000.00
	<hr/> 29,094.40
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$2,764.94
July 1, 1889, outstanding liabilities.....	143.83
	<hr/> 2,908.77
July 1, 1889, balance available	<hr/> 26,185.63
{ Amount (estimated) required for completion of existing project.....	58,096.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	30,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix C 10.)	

11. *Newport Harbor, Rhode Island.*—Before improvement the capacity of the inner harbor was limited by shoals, and it was not adequate to the number and size of the vessels seeking it for refuge. The southern or main entrance was obstructed by a bar which stretched out from Goat Island, and the general business wharves of the city could not be reached at low tide by vessels drawing more than 8 feet.

The original project and its subsequent modification, under which work is now carried on, are substantially as follows:

Deepening the southern entrance to 15 feet at mean low water and widening it by dredging Goat Island Spit northward to a line drawn from the dolphin which marks the Spit, to clear the permanent dock at Fort Adams by 100 feet; the excavation of a channel 750 feet wide and 15 feet deep at mean low water around and to the eastward of this dolphin; deepening to 13 feet at mean low water the area included between the 13-foot curve on the west, a line drawn from the southwest corner of Perry Mill Wharf to Lime Rock on the south, the harbor line on the east, and a line drawn parallel to and 50 feet from the city wharf on the north; deepening to 10 feet at mean low water the area northwest of a line drawn from Lime Rock through the spindle which is in the southeast part of the harbor, and excavating a channel 10 feet deep at mean low water along and outside the harbor line south to a point opposite the gas company's wharf; and the construction of jetties on the western shore of Goat Island to arrest the drift of littoral sand and gravel into the entrance of the harbor.

The amount expended up to the close of the fiscal year ending June 30, 1888, was \$108,124.23, with the following results:

Of the area to be dredged to 13 feet within the harbor, about nine-tenths had been completed. The channel along and outside the harbor line south to a point opposite the gas company's wharf and the 15-foot channel, 750 feet wide, around and to the eastward of the Dolphin on Goat Island Spit, had been completed, with the exception of a narrow strip along the western edge and to the north of the dolphin. The increase of width to be made between the 15-foot curves at the southern entrance by dredging in the spit south of Goat Island had been completed. The berth for vessels at the quartermaster's wharf at Fort Adams had been deepened to 10 feet at mean low water, and the littoral sand from the outside of Goat Island had been stopped for the present from washing into the channel at the southern entrance of the harbor by the construction of a jetty on the west side of the island. The southern entrance is completed for vessels of 15 feet draught, and of the total area to be dredged within the harbor (about 90 acres) about two-thirds have been completed. Nothing has been done during the past fiscal

year owing to the impossibility of obtaining satisfactory prices for the work.

The work required to complete the existing project is the dredging of a narrow strip along the western edge of the 750-foot channel around and to the eastward of the dolphin on the Goat Island Spit; the remainder of the excavation within the harbor of the anchorage area of 13 feet depth; and the excavation, also within the harbor, of the anchorage area of 10 feet depth; also, the building of additional jetties outside of Goat Island whenever they may be required.

July 1, 1888, amount available	\$77.80
Amount appropriated by act of August 11, 1888.....	12,000.00
	<hr/>
	12,077.80
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$1,200.65
July 1, 1889, outstanding liabilities.....	164.33
	<hr/>
	1,364.98
July 1, 1889, balance available	10,712.82
	<hr/>
{ Amount (estimated) required for completion of existing project.....	40,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	25,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix C 11.)	

12. *Harbor of Refuge at Block Island, Rhode Island.*—The object of the improvement is to furnish a harbor of refuge for vessels engaged in foreign and coastwise commerce.

Before the construction of the present harbor Block Island had no harbor which afforded protection for decked vessels. The original project and its subsequent modifications provide for a harbor of refuge on the eastern side of the island, consisting of an inner harbor or basin for small vessels and an exterior for large ones. The basin was to be about 250 feet by 300 feet in area and inclosed, with the exception of an opening 80 feet wide. The exterior harbor was to be formed by a riprap breakwater, which has been built. About 300 feet from the sea end of this breakwater, which is 1,900 feet long, a gap 200 feet long was left for the convenience of vessels. The present project contemplates the filling of this gap and restoring the breakwater to its original dimensions, the enlargement of the inner harbor, and the removal of a shoal along the western side of the breakwater.

The total expenditures up to June 30, 1888, were \$339,008.72.

The inner harbor and the main breakwater, built in prolongation of the eastern side of the inner harbor, and extending 1,900 feet from the shore, were constructed in the years 1870 to 1879, inclusive. The utility of the work at once became apparent. In stormy weather the inner harbor, especially, was filled with fishermen and coasters, and it soon became necessary to increase its depth from 7 feet, to which it had been dredged in the first instance, to 9 feet at mean low water. A strong jetty had been built out from the cliff to the eastward of the inner harbor, and a masonry wall constructed on the inside of the crib-work forming the eastern side of the inner harbor. The filling in the gap in the main breakwater had been carried to an extent sufficient to keep out the sea, which was formerly driven through it into the outer harbor in easterly storms.

The timber jetty filled with stone forming the shore end of the west-

ern wall of the enlarged inner harbor had been finished and the construction of its north wall had been commenced.

During the past fiscal year work has been in progress on the enlargement of the inner harbor, and 3,530 tons of riprap granite has been placed in the north wall. Nothing has been done under the appropriation of August 11, 1888, owing to the impossibility of obtaining satisfactory prices for the work.

It is proposed to apply the funds available July 1, 1889, and the appropriation asked for, to the completion of the filling of the gap in the breakwater, the restoration of the breakwater to its original dimensions, the continuation of the enlargement of the inner harbor, and the removal of the sand bar along the western side of the breakwater.

July 1, 1888, amount available.....	\$776. 79
Amount appropriated by act of August 11, 1888.....	15, 000. 00

15, 776. 79	
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$1, 892. 67
July 1, 1889, outstanding liabilities.....	30. 00
	1, 922. 67

July 1, 1889, balance available:	
Breakwater.....	3, 633. 78
Inner harbor.....	5, 295. 43
Removing sand-bar.....	4, 924. 91
	13, 854. 12

{ Amount (estimated) required for completion of existing project.....	30, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	30, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C 12.)

13. *Pawcatuck River, Rhode Island and Connecticut.*—The navigable part of the Pawcatuck River extends from the town of Westerly to Little Narragansett Bay, and the object of the improvement is to deepen and widen the channel leading from this bay to Westerly.

Before improvement, the channel was crooked and obstructed by numerous shoals, on some of which there was but $1\frac{1}{2}$ feet of water at mean low water.

By appropriations made in the years 1871 to 1875 the river was improved by the excavation of a channel $5\frac{1}{2}$ feet deep at mean low water and 75 feet wide below the wharves, and from 35 to 40 feet wide between the upper and lower wharves. The present project contemplates the further widening of the channel to 100 feet below the wharves and by an additional width of two cuts of an ordinary dredging machine, or about 40 feet, between the lower and upper wharves; also the deepening of the entire channel to 8 feet at mean low water.

The amount expended on the present project to June 30, 1888, including outstanding liabilities, was \$10,463.62, and the result was the completion of the channel to its full width and depth from the deep water opposite the village of Lottery to a point near the lower end of Major's Island, with the exception of a small amount of ledge rock which extends into the channel near Certain Draw Point and at Pawcatuck Rock.

During the past fiscal year 8,355.6 cubic yards of material and 5.92 cubic yards of bowlders have been removed from the channel. Nothing

has been done under the appropriation of August 11, 1888, owing to the impossibility of obtaining satisfactory prices for the work.

The funds available and the appropriation asked for will be applied to the completion of the existing project.

July 1, 1888, amount available.....	\$399.00
Amount appropriated by act of August 11, 1888.....	10,000.00
	<hr/> 10,399.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$789.77
July 1, 1889, outstanding liabilities.....	35.38
	<hr/> 825.15
July 1, 1889, balance available.....	9,573.85
	<hr/>
{ Amount (estimated) required for completion of existing project.....	16,637.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	16,600.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See appendix C 13.)

14. *Harbor of refuge at Stonington, Connecticut.*—Stonington Harbor originally was an open bay, unprotected from southerly storms and obstructed by a shoal having a low-water depth of but 6 feet at the shoalest part. A short breakwater was constructed in the years 1828–1831, at a cost of \$34,766.65, for the protection of the commerce of the town. The enlarged project of 1871 for the improvement of the harbor and its subsequent modification, under which work is now carried on, embraced dredging in the upper harbor and the construction of two breakwaters in the outer harbor. One of these, the western, was to be built out from Wamphassuck Point, the southwestern limit of the harbor, and to extend about 2,000 feet; and the other, the eastern, was to extend from the vicinity of Bartlett's Reef to the Middle Ground. The western breakwater was completed in 1880 at a cost of \$103,190. The amount expended in dredging in the upper harbor was about \$45,000. The position of the western end of the eastern breakwater has not been determined.

The amount expended on the eastern breakwater up to the close of the fiscal year ending June 30, 1888, was \$109,548.90, and its length at that date was 2,210 feet.

The amount expended during the last fiscal year, including outstanding liabilities June 30, 1889, was \$5,440.76, and the result was the extension of the eastern breakwater to a point about 2,240 feet from its eastern extremity.

The work required is to finish the construction of the eastern breakwater. In case it be found that sufficient protection to the harbor of refuge has been afforded when the range from Stonington Light to the middle of Wicopessit Island is reached, the length of the breakwater yet to be built will be about 330 feet. Should it be decided to extend it to the Middle Ground it will require about 150 feet more.

The completion of this work will afford a thoroughly protected anchorage for vessels drawing 18 feet of water and a harbor of refuge for the commerce which daily passes between Long Island Sound and the eastward.

It is proposed to apply the amount available and that asked for to the extension of the eastern breakwater.

July 1, 1888, amount available	\$450. 80
Amount appropriated by act of August 11, 1888	8,000. 00
	<hr/>
	8,450. 80
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$3,485. 46
July 1, 1889, outstanding liabilities	1,955. 30
July 1, 1889, amount covered by existing contracts.....	2,097. 20
	<hr/>
	7,537. 96
	<hr/>
July 1, 1889, balance available	912. 84
	<hr/>
{ Amount (estimated) required for completion of existing project.....	25,000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	25,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix C 14.)	

15. *Removing sunken vessels or craft obstructing or endangering navigation—Wreck of schooner Alma.*—This vessel caught fire, somewhere off the coast of Cape Cod, about September 26, 1888, and was towed to Vineyard Haven Harbor and left by the tow-boat at a shoal spot some 1,200 feet northeast of the steam-boat wharf. A contract for its removal was made, and the work was completed May 1, 1889, after considerable delay by reason of bad weather.

Wreck of schooner Annie E. Hayes, sunk in Buzzard's Bay, Massachusetts, December 5, 1888. A contract for the removal of this wreck was made and the work completed May 1, 1889.—(See Appendix C 15.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examination of *Entrance to Point Judith Pond, west of Point Judith, Rhode Island, with a view to establishing a harbor of refuge*, was made by the local engineer in charge, Major Livermore, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers concurring in the conclusion reached in this instance, has given no instructions to make further survey with the view to its improvement.—(See Appendix C 16.)

At the following localities reported by the local engineer as worthy of improvement, and this conclusion being concurred in by the Chief of Engineers, the result of the preliminary examination containing information sufficient to indicate to Congress the probable cost of the work required, no further report or survey appeared to be necessary.

1. *Westport Harbor and East and West Branch of Westport River, Massachusetts.*—Estimated cost of improvement \$2,000, to be applied to extending the jetty on Horse Neck Point, and to dredging in Westport Harbor.—(See Appendix C 17.)

2. *Taunton River, Massachusetts.*—Estimated cost of improvement proposed \$14,050, to be applied to dredging and the removal of ledge rock and boulders.—(See Appendix C 18.)

3. *Fishing Place Cove, near Seaconnet Point, Rhode Island, with view to constructing breakwater.*—Estimated cost of improvement \$5,000, to be applied to restoring the existing dilapidated breakwater for at least a portion of its length, and to dredging a small area inside the cove.—(See Appendix C 19.)

4. *Greenwich Bay, to deepen water on the Bar at Long Point, Rhode Island.*—Estimated cost of improvement \$2,000, to be applied to widening the existing channel.—(See Appendix C 20.)

It appearing from the report of the preliminary examination made by the local engineer that the following localities are worthy of improvement, and the public necessity therefor being apparent from the facts and reasons reported, which are concurred in by the Chief of Engineers, Major Livermore was charged with their survey, the results of which will be submitted when received:

1. *Martha's Vineyard, inner and outer harbor at Edgartown, Massachusetts.*

2. *Cove near southeast extremity of Coaster's Harbor Island, and water-way between said island and Rhode Island, with a view to deepening the water way and removing obstructions.*

3. *Coast near life-saving station, East Point Judith, Rhode Island, with a view to constructing a breakwater.*

4. *Narragansett Bay at the mouth of Narrow River, Rhode Island, with a view of constructing a breakwater.*

IMPROVEMENT OF CONNECTICUT RIVER, MASSACHUSETTS AND CONNECTICUT, AND OF RIVERS AND HARBORS ON LONG ISLAND SOUND, CONNECTICUT AND NEW YORK.

Officer in charge, Lieut. Col. D. C. Houston, Corps of Engineers, with Lieut. J. C. Sanford, Corps of Engineers, under his immediate orders, until February 26, 1889.

1. *Thames River, Connecticut.*—This river is a tidal stream, extending from the city of Norwich 15 miles south to Long Island Sound. For 11 miles above its mouth the depth ranges from 13 to 80 feet. Improvements have, until 1889, been confined to a stretch of $3\frac{1}{2}$ miles below Norwich, in which the most troublesome bars lay. In 1829 the channel depth over these bars was about 6 feet at mean low water.

In 1836 a project was adopted for making the channel 100 feet wide and 14 feet deep at mean high water (11 feet at low water) by dredging and building piers. In 1878 a channel 14 feet deep at low water was projected, and in 1882 a modification was adopted providing for a channel 200 feet wide and 14 feet deep at mean low water, to be obtained by dredging and by building five dikes or training-walls along the outer sides of the channel curves. The estimated cost was \$208,080, and a balance of \$20,000 from previous appropriations was then available. In 1888 the project was modified to include making 16 feet depth as far up as Allyn's Point, and 14 feet from there to Easter's Point, at an additional cost of \$40,000.

The total amount appropriated for this river is \$354,300, of which \$133,510.64 has been expended since the adoption of the project of 1882.

Three of the proposed dikes have been completed, and the fourth one nearly so. Dredging was done between the dikes in 1882, 1883, 1884, 1887, and 1888. The three completed dikes need slight repairs. The channel has an available low-water depth of 11 feet.

During the past fiscal year, including outstanding liabilities and excluding existing contracts, \$23,379.77 have been expended in dredging.

Fifty thousand dollars could be profitably expended during the next fiscal year.

July 1, 1888, amount available.....	\$1,350.89
Amount appropriated by act of August 11, 1888	50,000.00
	51,350.89

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$20,768.64
July 1, 1889, outstanding liabilities	2,611.13
July 1, 1889, amount covered by existing contracts.....	7,850.00
	31,229.77

July 1, 1889, balance available	20,121.12
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{ Amount (estimated) required for completion of existing project	95,600.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	50,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 1.)

2. *New London Harbor, Connecticut.*—This harbor includes the lower 3 miles of Thames River, from New London to Long Island Sound.

The project of its improvement, adopted in 1880 and slightly modified in 1882, provides for removing to a depth of 16 feet at mean low water the southerly part of a shoal of sand and bowlders lying east of the New London Northern Railroad Wharf. The original depth on this part of the shoal was from 5 to 15 feet.

Nineteen thousand eight hundred dollars have been appropriated for and expended on this work.

Nothing was done during the past fiscal year.

The required depth has been made over nearly the whole area contemplated in the project, which is regarded as completed, no further work under it being desired.

July 1, 1888, amount available	\$201.39
July 1, 1889, balance available	201.39

(See Appendix D 2.)

3. *Connecticut River, Massachusetts and Connecticut, above Hartford.*—From Holyoke, Mass., 34 miles above Hartford, down to Enfield Falls or Rapids, a distance of 18 miles, there is a fair channel 4 to 5 feet deep. Enfield Rapids extends about 5 miles over a rocky and uneven bed, with a total fall of 32 feet. From the foot of Enfield Rapids to Hartford, a distance of 11 miles, the river-bed is broad and sandy, with a channel from 2 to 5 feet deep at low water. Several years ago the Connecticut River Company constructed a small canal around Enfield Rapids, through which boats of 3 feet draught and 80 feet length can pass.

The several projects under which work has been done have been for dredging at Barber's Landing and for wing-dams. In 1878 plans and estimates were submitted for the construction of a canal 8 feet deep around Enfield Rapids; these estimates were revised in 1880. The estimated cost of this canal was \$1,322,805; it was not considered advisable to commence construction with a less sum than \$450,000, which has not yet been appropriated.

Up to the close of the present fiscal year \$100,000 have been appropriated for this part of the river, of which \$90,866.80 have been expended.

All the work done has been dredging and the construction and repair of seven wing-dams.

No work was done during the past fiscal year.

The funds on hand from previous appropriations are sufficient for such repairs and temporary improvement as may be needed during the ensuing fiscal year.

The benefit to be secured by a permanent improvement would be the reduction of cost of transporting bulky materials to and from a large manufacturing district now wholly dependent on railroads.

July 1, 1888, amount available	\$9, 133. 20
July 1, 1889, balance available	9, 133. 20

Below Hartford.—Between Hartford and Long Island Sound, a distance of 50 miles by course of channel, the depth on the bars was formerly 5 feet at low water, the worst places being between Hartford and Middletown, a distance of 19 miles, and at Saybrook Bar, at the mouth of the river. Dredging was carried on and small wing-dams were constructed by private parties and by a State corporation up to 1868 with no permanent benefit.

In 1868 a project for improvement by the United States was submitted, under which a pile-dike was built at Hartford and annual dredging done on the bars below Hartford until 1883. In 1873 a project for the construction of three jetties on Saybrook Bar was adopted; two of these have been built; the third will probably not be required. In 1880 a project for permanent improvement on six of the worst bars between Hartford and Middletown was adopted. It contemplated building riprap wing-dams, rectifying the banks and protecting the caving banks by mattresses, at a total estimated cost of \$330,487. It was afterwards found necessary to extend the project to include annual dredging at these and other bars and the extension and repair of the Saybrook jetties. The total amount appropriated since the adoption of the above project is \$156,250. Two of the contemplated permanent works have been built, a training-wall at Hartford Bar and a wing-dam at Glastonbury Bar, their total cost being \$40,715.34. In addition to the work included in the estimate of \$330,487, the east and west jetties at Saybrook have been extended and repaired and a channel over 120 feet wide and 12 feet deep has been dredged between them, and from \$5,000 to \$10,000 have been annually expended in dredging to maintain a depth of 9 feet on the bars between Hartford and Saybrook.

Experience has shown that, on account of the height and frequency of freshets in this river, the permanent works projected in 1880 would be inadequate to maintain the desired depth or even to materially reduce the amount of dredging annually required. Therefore, in December, 1887, a new project was adopted, confining future operations to the completion of the Saybrook jetties to a height of 5 feet above high water, with a top width of 6 feet, and widening the channel between the jetties to 400 feet, with a depth of 12 feet at mean low water, at an estimated cost of \$80,000, with annual dredging to maintain a 9-foot channel between Hartford and Long Island Sound, at an average cost of \$10,000 per year.

During the past fiscal year, including outstanding liabilities and excluding existing contracts, \$6,488.69 have been expended in dredging to widen the channel between the Saybrook jetties and to maintain the channel in the river.

July 1, 1888, amount available.....	\$3, 744. 37
Amount appropriated by act of August 11, 1888.....	10, 000. 00
	<hr/> 13, 744. 37

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$4, 154. 52
July 1, 1889, outstanding liabilities.....	2, 334. 17
July 1, 1889, amount covered by existing contracts.....	3, 000. 00
	<hr/> 9, 488. 69

July 1, 1889, balance available.....	<hr/> 4, 255. 68
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{ Amount (estimated) required for completion of existing project.....	\$80,000.00
{ Amount (estimated) required for annual maintenance of channel.....	10,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	25,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix D 3.)	

4. *Clinton Harbor, Connecticut.*—This harbor is 10 miles west of the mouth of the Connecticut River. Its channel runs for nearly a mile inside of a beach, through which a breach was made about the year 1840, after which the channel shoaled in two places to about 4 feet depth where the depth had been 8 feet.

The project for improvement, adopted in 1882, provided for closing the breach, and, if that did not restore the channel depth, for dredging a channel 100 feet wide and 6 feet deep at mean low water through the shoals. The entire cost was estimated at \$10,000.

Three thousand dollars have been appropriated for this harbor, of which \$2,747.27 have been expended.

A riprap dike was built across the breach in 1883; it requires some repair. The channel depth has not changed since 1882.

Nothing was done during the past fiscal year.

Seven thousand dollars, the estimated amount required to complete the project, could be profitably expended for that purpose in the next fiscal year.

July 1, 1888, amount available	\$252.73
July 1, 1889, balance available	252.73

{ Amount (estimated) required for completion of existing project.....	7,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	7,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 4.)

5. *New Haven Harbor, Connecticut.*—The original available low-water depth up to the wharves in this harbor was about 9 feet.

The first project for deepening the channel provided for making it 13 feet deep, which was done in 1871. It was widened at different times until 1878, when a project was adopted for dredging a channel 16 feet deep and not less than 400 feet wide. In 1882 a project was adopted for building a dike to extend out from Sandy Point, with an arm 3,200 feet long, and parallel to the channel, in order to contract the channel and make the depth on Fort Hale Bar, to be obtained by dredging, permanent. Fifty-three thousand dollars (including a contract now in progress) have been expended on this dike, and \$31,000 are estimated as required to complete it.

Up to the close of the fiscal year \$276,000 have been appropriated for this harbor, and nearly all expended.

A 16 foot channel, from 400 to 600 feet wide, has been obtained all the way up the harbor, except over the Fort Hale Bar, where the depth is 13 feet. The shore-arm and 1,769 feet of the channel-arm of the Sandy Point dike have been built.

During the past fiscal year \$7,170.10 has been expended in extending the Sandy Point dike 410 feet.

The sum of \$30,000 can be used in completing the dike and dredging over the Fort Hale Bar.

July 1, 1888, amount available	\$1,329.96
Amount appropriated by act of August 11, 1898.....	15,000.00
	<hr/> 16,329.96
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$3,650.21
July 1, 1889, outstanding liabilities.....	3,519.89
July 1, 1889, amount covered by existing contracts.....	8,000.00
	<hr/> 15,170.10
July 1, 1889, balance available	1,159.88
	<hr/>
{ Amount (estimated) required for completion of existing project.....	78,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	30,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix D 5.)	

6. *Breakwater at New Haven, Connecticut.*—In 1880 a project was adopted for making a harbor of refuge at the entrance to New Haven Harbor by the construction of two riprap breakwaters, the first to be 3,300 feet long, extending northeasterly from the light-house on Southwest Ledge to Quixes Ledge; the second to be 4,200 feet long, extending northwesterly from Luddington Rock. The estimated cost was \$1,311,134. No modification of the project has been adopted, except slight changes of cross section in 1880.

The total amount appropriated for this work is \$370,000, of which \$317,284.69 have been expended.

During the past fiscal year, including outstanding liabilities, and excluding existing contracts, \$22,374.90 has been expended, and the breakwater has been extended 352 feet. A contract for extension is in progress, under which the east breakwater will be completed.

The east breakwater is now 3,170 feet long; the west breakwater is not begun.

The river and harbor act of August 11, 1888, provided, "And the Chief of Engineers may, if deemed necessary, relocate the western breakwater, and the Secretary of War is authorized, in his discretion, to expend any portion of said sum in commencing its construction." An examination in reference to this matter was made in the fall of 1888, and the results reported in a letter dated January 26, 1889 (see Appendix D 6). The estimated cost of a harbor such as would meet the wishes of the harbor commissioners is \$5,000,000. So large an expenditure does not seem to be warranted by the present demands of commerce. At the same time, the harbor as designed is not of sufficient capacity and is now exposed to southerly and southwesterly storms. Vessels will not lie at anchor immediately behind the easterly breakwater, owing to the existence of submerged rocks, having over them a minimum depth of 5 feet, so that the anchorage ground which it really protects is that above Five Mile Point, which is limited in area, and its use by vessels seeking refuge interferes with the channel to the wharves at New Haven. What is needed is a harbor easily accessible and the occupation of which will not interfere with the local harbor. They should be two distinct harbors.

The entrance to the harbor, according to the present plan, between Luddington Rock and Southwest Ledge, is 3,500 feet wide. This width is unnecessarily great, and might be reduced without interfering with the free passage of vessels, and better protection be afforded the harbor.

From an examination made by the officer in charge, it appears that the present and prospective demands of commerce for a long time to come would be met by changing the location of the western breakwater to the southwest about 6,000 feet, and constructing a breakwater crossing Luddington Rock on a course S. 54° W., commencing at a point on this line 1,000 feet N. 54° E. from Luddington Rock, and extending S. 54° W. 5,000 feet, leaving an opening of 2,000 feet or less between its western end and the southern end of the westerly breakwater, in its proposed change of location. The location of these works is shown on a sketch with Appendix D 6. The cost, in addition to the present estimates of \$1,311,134, will be about \$750,000. The space behind the breakwater proposed through Luddington Rock is free from obstructions and has a depth of from 15 to 29 feet, with good holding ground; it can be reached at the eastern end with a depth of 17 feet and at the western end with a depth of 29 feet. This plan will not interfere with its extension further to the westward should the necessities of commerce demand it in the future.

This work should commence at Luddington Rock and extend in both directions as funds are provided. This rock, which now forms an obstruction, will be covered by the breakwater, and a permanent beacon at the eastern end will, with the light-house on Southwest Ledge, clearly mark the entrance. The entrance between them will be 2,500 feet wide, with a minimum depth of 17 feet and a maximum depth of 25 feet.

For the better protection of the harbor, the space between the eastern breakwater and the shore, a distance of 2,000 feet, should be partially closed by a breakwater, extending from the shore towards the east end of the easterly breakwater, leaving an opening in the present eastern channel 13 feet deep, of 800 feet width. The cost of this is estimated at \$90,000. It is not as important as the works proposed on the western side of the harbor, and may be deferred until they are completed.

Whichever plan be adopted for the westerly breakwaters, during the ensuing fiscal year \$250,000 could be profitably expended towards its execution.

July 1, 1888, amount available.....	\$91.21
Amount appropriated by act of August 11, 1888.....	75,000.00
	<hr/> 75,091.21

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$17,845.66
July 1, 1889, outstanding liabilities.....	4,530.24
July 1, 1889, amount covered by existing contracts.....	29,280.00
	<hr/> 51,655.90

July 1, 1889, balance available.....	<hr/> 23,435.31
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{ Amount (estimated) required for completion of existing project.....	941,134.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	250,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 6.)

7. *Milford Harbor, Connecticut.*—This harbor consists of a broad, open bay, from the head of which a small tidal stream extends three-quarters of a mile inland to the upper wharf. Originally the depth on the bar at the mouth of the river was less than 2 feet at mean low tide; the channel in the river ran nearly bare in places.

Under the first project of improvement, adopted in 1872, a channel 4 feet deep and 100 feet wide was excavated through the bar, and thence 40 to 60 feet wide to the upper wharf; small jetties were built to pro-

tect the east bank from erosion and two jetties were built to preserve the channel on the bar, at a total cost of \$34,000. In 1881 a project was adopted for making the channel over the bar 8 feet deep at mean low water and 100 feet wide, at an estimated cost of \$11,000.

The total sum appropriated for this harbor is \$44,600; of this amount about \$8,000 has been expended on the last project, completing the 8-foot channel to 100 feet width.

During the past fiscal year the 8-foot channel was completed to the projected width and partial repairs were made to Long Jetty.

The project is completed, but \$2,500 will be required for necessary repairs to the jetties.

July 1, 1888, amount available.....	\$241.02
Amount appropriated by act of August 11, 1888.....	5,000.00

5,241.02

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$2,214.89
July 1, 1889, outstanding liabilities.....	1,621.78

3,836.67

July 1, 1889, balance available.....	1,404.35
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{ Amount that can be profitably expended in fiscal year ending June 30, 1891	2,500.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 7.)

8. *Housatonic River, Connecticut.*—The navigable part of this river extends from Derby, Conn., to Long Island Sound, a distance of 13 miles, and was originally obstructed by several bars, upon which the low-water depth was from 3 to 5 feet.

In 1871 a project was adopted for making and maintaining a channel 100 feet wide and 7 feet deep at mean low water throughout this distance. Besides the necessary dredging, it contemplated building a breakwater east of the channel over the bar at the river's mouth.

The amount appropriated for this river is \$111,242, of which \$75,250.82 has been expended, including outstanding liabilities.

A channel of required depth has been dredged several times through the worst bars. The present available depth over them is about 5 feet at mean low water. Drew's Rock has been removed to a depth of 7 feet.

During the fiscal year contracts have been entered into for dredging and for breakwater construction, but work has not yet been begun.

The estimated cost of the breakwater and of the necessary dredging, as revised in 1887, was \$202,000, of which \$35,000 has been appropriated; \$70,000 could be advantageously expended on this work during the next fiscal year.

July 1, 1888, amount available.....	\$1,705.41
Amount appropriated by act of August 11, 1888.....	35,000.00

36,705.41

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$614.23
July 1, 1889, outstanding liabilities.....	100.00
July 1, 1889, amount covered by existing contracts.....	27,860.00

28,574.23

July 1, 1889, balance available.....	8,131.18
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{ Amount (estimated) required for completion of existing project.....	\$167,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	70,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 8.)

9. *Bridgeport Harbor, Connecticut.*—The available depth in this harbor was originally 5 feet at mean low water.

The first project for improvement provided for an 8-foot channel over the outer and inner bars. This was dredged on the outer bar in 1837, and on both bars in 1853. In 1871 a project was adopted for making a channel 12 feet deep and 100 feet wide, subsequently modified to 300 feet, and for building a jetty on the east shore to check the influx of sand. This was accomplished in 1882, and a new project was adopted for widening to 600 feet the channel from the Inner Beacon to the Naugatuck Railroad wharf, to provide for vessels driven in by bad weather, without blocking the main channel. The estimated cost of the latter project was \$60,000. It is very nearly completed. A small area remains near the Inner Beacon, which it is considered desirable to dredge. The project was extended in 1888 to include widening the channel above the railroad wharf, in order to relieve the crowding of the channel at that point, and was further extended by act of Congress authorizing the expenditure of the last appropriation towards dredging a 9-foot channel up to the head of the upper harbor, above the bridges, the total estimated cost of which is \$35,000. In addition to this, a further extension has been asked by citizens to provide for a breakwater from the Tongue to the Inner Beacon, estimated to cost \$30,000.

The total amount appropriated for this harbor is \$242,485.38, nearly all of which has been expended.

During the past fiscal year the 9-foot channel has been extended about three-quarters way up the upper harbor above the bridges.

Fifty-five thousand dollars is estimated to be necessary to complete the project, including the breakwater at the Tongue. Twenty-five thousand dollars could be expended to advantage during the next fiscal year.

July 1, 1888, amount available.....	\$197.06
Amount appropriated by act of August 11, 1888.....	10,000.00
	<hr/> 10,197.06

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	
July 1, 1889, outstanding liabilities.....	\$1,418.41
July 1, 1889, amount covered by existing contracts.....	5,269.50
	<hr/> 1,070.28
	<hr/> 7,758.19

July 1, 1889, balance available.....	<hr/> 2,438.57
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{ Amount (estimated) required for completion of existing project.....	55,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	25,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 9.)

10. *Black Rock Harbor, Connecticut.*—This harbor consists of a bay partly sheltered by Fairweather Island and of two small streams extending inland from the head of the bay. The depth in Cedar Creek, the more important of these streams, was from 2 to 4 feet at mean low water, and the channel was narrow and very crooked.

The project for improvement, submitted in 1883, includes dredging a channel 3,300 feet long, 80 feet wide, and 6 feet deep, to extend up

Cedar Creek, and a breakwater from Fairweather Island to the mainland. The estimated cost was \$80,000.

Thirty-five thousand dollars has been appropriated for and, including a contract now in force, expended under this project, making the proposed channel up as far as the Forge Company's wharf.

During the past fiscal year a contract for extending the channel by dredging has been made, but work under it is not yet begun.

The breakwater has been built to the full length, but not to the width and height projected; it needs slight repairs.

July 1, 1888, amount available.....	\$140. 30
Amount appropriated by act of August 11, 1888.....	10, 000. 00

10, 140. 30

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$55. 74
July 1, 1889, amount covered by existing contracts.....	8, 000. 00

8, 055. 74

July 1, 1889, balance available.....	2, 084. 56
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{ Amount (estimated) required for completion of existing project.....	45, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	20, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 10.)

11. *Norwalk Harbor, Connecticut.*—This harbor consists of the tidal part of Norwalk River, about 3 miles long, and of the harbor between Norwalk Islands and the mainland. South Norwalk, on the river, is about $1\frac{1}{2}$ miles below Norwalk. Originally the depth up to South Norwalk was about 5 feet at mean low water; between there and Norwalk the river-bed runs nearly bare.

The first project for improvement contemplated a channel 100 feet wide and 6 feet deep to Norwalk. In 1881 the project was modified to provide for a depth of 8 feet below South Norwalk. The last estimate upon this work places the cost from commencement at \$84,000.

Up to the close of the fiscal year \$80,246.66 had been appropriated for this project and nearly all expended. Some parts of the river have required dredging several times.

A channel has been dredged 100 feet wide and 8 feet deep up to South Norwalk, and thence to Norwalk from 60 to 100 feet wide and 6 feet deep. This channel is now in good condition.

The river and harbor act of August 11, 1888, appropriated \$28,000 for improvement of the harbor, and provided that \$25,000 should be expended in dredging and deepening the lower harbor up to Wilson's Point. The estimated cost of the latter work was \$52,900.

During the fiscal year the money available for dredging in the river was expended in removing shoals from the sides of the channel, and that required to be applied to the channel at Wilson's Point is partly expended under a contract not yet completed.

Owing to the low price obtained for the work at Wilson's Point, and to the fact that a large part of the contemplated work had been done by a railroad company whose terminal docks are there, the work can be completed as desired with the remaining funds, and no further appropriation is needed at this point.

The remainder of the estimate for work in the river, \$4,000, could be profitably expended during the next fiscal year.

July 1, 1888, amount available.....	\$503.10
Amount appropriated by act of August 11, 1888.....	28,000.00
	<hr/> 28,503.10
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$14,153.13
July 1, 1889, outstanding liabilities.....	1,209.94
July 1, 1889, amount covered by existing contracts.....	3,300.55
	<hr/> 18,663.62
July 1, 1889, balance available.....	<hr/> 9,839.48
<hr/>	
{ Amount (estimated) required for completion of existing project.....	4,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	4,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix D 11.)	

12. *Harbor at Five Mile River, Connecticut.*—This harbor is a small inlet over a mile long and from 300 to 800 feet wide, on the north shore of Long Island Sound. The natural low water depth at the mouth is about 3 feet at low water, shoaling to zero about half way up the harbor.

The project for improvement, proposed in a report on a survey made in 1886 and adopted under the appropriation of \$5,000 made August 11, 1888, provides for dredging a channel 8 feet deep at mean low water, 100 feet wide, and about 6,000 feet long, extending to the head of the harbor; the cost was estimated at \$25,000.

During the past fiscal year an 8-foot channel has been made about 40 feet wide and 750 feet long under a contract now in progress.

The estimated amount to complete this improvement is \$20,000, of which \$10,000 could be profitably expended during the next fiscal year.

Amount appropriated by act of August 11, 1888.....	\$5,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$383.53
July 1, 1889, outstanding liabilities.....	1,859.50
July 1, 1889, amount covered by existing contracts.....	2,756.97
	<hr/> 5,000.00
<hr/>	
{ Amount (estimated) required for completion of existing project.....	20,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix D 12.)	

13. *Stamford Harbor, Connecticut.*—This harbor consists of a shallow bay on the north shore of Long Island Sound and of the tidal part, about three-fourths of a mile long, of Mill River. The original depth in this part of the river at mean low water was from 1 to 3 feet, gradually increasing in the bay to a depth of 12 feet.

The project for improvement, proposed in 1883 and adopted in 1886, provides for dredging a channel 80 feet wide and 5 feet deep at mean low water from the bay to the head of the harbor, at an estimated cost of \$20,000.

Fifteen thousand dollars has been appropriated and expended in making a channel 5 feet deep, 100 feet wide for more than half its projected length, and from 25 to 50 feet wide the rest of the distance.

During the past fiscal year dredging has been done to widen the channel.

The estimated amount required to complete the project, \$5,000, could be profitably expended during the next fiscal year.

July 1, 1888, amount available	\$224. 08
Amount appropriated by act of August 11, 1888	5, 000. 00
	<hr/> 5, 224. 08
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	4, 593. 74
July 1, 1889, balance available	<hr/> 630. 34
{ Amount (estimated) required for completion of existing project.....	5, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	5, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix D 13.)	

14. *Port Chester Harbor, New York.*—This harbor consists of a bay opening into Long Island Sound at the mouth of the Byram River, and of the lower part of the river itself, which is navigable for about a mile above its mouth.

The original available depth in the river was not above a foot at low water, and Salt Rock in the river and Sunken Rock in the bay were considered dangerous obstructions.

The scheme for improvement, adopted in 1871, provided for the removal of these rocks to 9 and 11 feet depth, respectively, and for the construction of a breakwater at Byram Point, at the mouth of the harbor, the estimated cost being \$96,632.

In 1884 the project was amended to provide for dredging a channel 2½ feet deep and from 60 to 100 feet wide from the bay to the vicinity of the wharves.

In 1888 the project was further modified to omit the removal of Sunken Rock, and to build a breakwater from that rock towards Byram Point, which should also serve as a beacon on the rock.

The total amount appropriated for this harbor is \$32,000, which has been nearly all expended. Salt Rock has been removed to the required depth of 9 feet at mean low water, a channel 2½ feet deep and from 40 to 100 feet wide has been completed to within 150 feet of the Port Chester Bridge, with 25 feet width to the bridge, and during the past fiscal year 288 linear feet of the breakwater from Sunken Rock towards Byram Point have been built.

The remainder of the original estimate for completing the project is \$64,632. Ten thousand dollars could be advantageously expended during the next fiscal year.

July 1, 1888, amount available	\$24. 77
Amount appropriated by act of August 11, 1888.....	5, 000. 00
	<hr/> 5, 024. 77
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	5, 010. 06
July 1, 1889, balance available	<hr/> 14. 71
{ Amount (estimated) required for completion of existing project.....	64, 632. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix D 14.)	

Echo Harbor, New Rochelle, New York.—The channel of this harbor was obstructed by two reefs, Start Rock and Sheepshead Rock, the former bare at low water, the latter covered to a foot depth or more.

The project for improvement adopted in 1875 provided for the removal of these reefs to 7 and 9 feet depths, respectively. The estimated cost was \$38,955.38.

Twenty-two thousand dollars has been appropriated for this harbor, of which \$18,956.03 has been expended. Start Rock has been wholly removed to 7 feet depth, and part of Sheepshead Rock to 9 feet depth.

The available funds were not sufficient for continuing operations on Sheepshead Rock, and nothing has been done during the past fiscal year. It is proposed to expend the available money in dredging during the present season.

According to the estimate the amount required for completion of the project is \$17,000, of which sum \$8,000 could be profitably expended in the ensuing year.

July 1, 1888, amount available	\$3,043.97
July 1, 1889, balance available	3,043.97

{ Amount (estimated) required for completion of existing project	17,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	8,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 15.)

16. *New Rochelle Harbor, New York.*—This harbor consists mainly of a narrow and crooked channel lying between rocky islands.

The project for improvement adopted in 1881 provided for the removal of two rocks and for dredging and removing a reef, to secure a channel 8 feet deep and 100 feet wide between Hunter's and Glen Islands. The estimated cost was \$40,825.

Thirty-five thousand dollars has been appropriated for this work.

The channel has been dredged 6 feet deep and the reef removed to 7½ feet; one of the rocks, Corning Rock, has been removed to the required depth of 12 feet; upon the other, Rock C, no work has been done.

During the past year proposals for dredging to 8 feet depth were advertised for, but no bids were received; there is no pressing need for completion of the project.

July 1, 1888, amount available	\$9,134.97
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	108.27

July 1, 1889, balance available	9,026.70
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(See Appendix D 16.)

17. *East Chester Creek, New York.*—This is a small tidal stream emptying into Pelham Bay; it was navigable at high tide only for vessels drawing 7 feet up to Lockwood's, a distance of 2½ miles. The rise of tide is 7.1 feet.

The project for improvement, adopted in 1872 and subsequently modified, provided for a channel 9 feet deep at mean high water, extending to a point 3,000 feet above Lockwood's and terminating at the upper end in a tidal basin. A revised estimate of the cost of the project, as modified, is placed by the officer in charge at \$221,100.

Sixty-four thousand dollars has been appropriated for this improvement.

The channel has been made 9 feet deep and 125 feet wide to the head of Goose Island, one-half mile from the mouth of the creek; thence to Town Dock 100 feet wide, and thence to Lockwood's nearly the same

width; above Town Dock 1,235 linear feet of diking have been built on the east side of the channel.

During the past fiscal year shoals have been removed between Town Dock and Lockwood's. A lay-out for the channel above Lockwood's was surveyed, and an unsuccessful effort was made to obtain consent of owners to the depositing of material to be dredged upon the adjacent marsh lands. Without this consent dredging would be very expensive, and the officer in charge considers it inexpedient to begin work, at least until \$25,000 is available.

The funds remaining are sufficient for all present needs below Lockwood's. Unless it is considered advisable to extend the improvement above Lockwood's no additional funds are needed. There is at present no navigation above this point, and it is problematical whether there will be to any great extent should the proposed improvement be made.

July 1, 1888, amount available	\$767. 60
July 1, 1888, amount covered by contract which was not completed.....	7, 650. 00
Amount appropriated by act of August 11, 1888.....	5, 000. 00

13, 417. 60

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	6, 254. 52
July 1, 1889, balance available	7, 163. 08

{ Amount (estimated) required for completion of existing project.....	152, 100. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 17.)

18. *Greenport Harbor, New York.*—This harbor, at the eastern end of Long Island, is exposed to easterly storms. Its anchorage ground, which was sheltered by Joshua's Point, has materially shoaled by the erosion of the point and by the influx of drifting sand.

The project for improvement, adopted in 1882, provided for the construction of a riprap breakwater, extending from Joshua's Point 1,700 feet in a southeasterly course, to arrest drifting sand, to check the erosion of the point, and to increase the sheltered area. Its cost was estimated at \$46,000.

Thirty thousand dollars has been appropriated towards this project, nearly all of which is expended or included in the contract now in progress.

During the past fiscal year the breakwater has been extended 98 feet under the above contract, using 2,410 tons of stone.

The present length of the breakwater is 1,535 feet.

July 1, 1888, amount available.....	\$40. 10
Amount appropriated by act of August 11, 1888.....	5, 000. 00

5, 040. 10

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$2, 553. 06
July 1, 1889, outstanding liabilities.....	1, 138. 11
July 1, 1889, amount covered by existing contracts.....	1, 217. 70

4, 908. 87

July 1, 1889, balance available.....	131. 23
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{ Amount (estimated) required for completion of existing project.....	16, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 18.)

19. *Glen Cove Harbor, New York.*—This harbor is an inlet on the east side of Hempstead Bay, which is accessible only at high tide, and a breakwater was needed to shelter vessels while lying at anchor and waiting for tides.

The project for improvement, proposed in a report on a survey made in 1886, and adopted under the appropriation of \$20,000 made August 11, 1888, provides for a riprap breakwater, about 2,500 feet long, extending in a west-southwesterly direction from the northwest corner of Glen Cove Dock; its estimated cost is \$201,960.

During the past fiscal year 220 linear feet of the breakwater have been built, under a contract now in progress.

The estimated cost of completing the work is \$191,600, of which \$30,000 could be profitably expended during the next fiscal year.

Amount appropriated by act of August 11, 1888.....	\$20,000.00	
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$1,380.86	
July 1, 1889, outstanding liabilities.....	2,836.94	
July 1, 1889, amount covered by existing contracts.....	7,664.06	
		11,881.86
July 1, 1889, balance available.....		8,118.14

{ Amount (estimated) required for completion of existing project.....	181,960.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	30,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 19.)

20. *Flushing Bay, New York.*—Before improvement, the available depth in this broad, shallow bay and in the channel leading up to Flushing was less than 4 feet at mean low water.

The project for improvement, adopted in 1879, contemplated building 16,700 feet of diking, to form a tidal basin which by filling and discharging through the main channel would maintain a channel depth of 6 feet or more at mean low water after once dredging; the bottom is soft mud. The estimated cost of this work was \$173,500. A modification of the project, adopted in 1888, omits a large part of the diking as probably not necessary.

Eighty-five thousand dollars has been appropriated for this work, of which \$69,045.42 has been expended, not including contract in progress.

The dike on the west side of the channel has been built 3,057 feet long, and the channel in the bay has been dredged, in some places two or three times.

During the past fiscal year a contract for extending the dike and for dredging has been made, under which work has just begun.

Thirty-five thousand dollars could be profitably expended during the ensuing fiscal year in extending the dike and maintaining the channel depth.

July 1, 1888, amount available.....	\$1,020.26	
Amount appropriated by act of August 11, 1888.....	15,000.00	
		16,020.26
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$65.69	
July 1, 1889, amount covered by existing contracts.....	1,014.80	
		10,280.49
July 1, 1889, balance available.....		5,739.77

Amount (estimated) required for completion of existing project.....	\$88,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1891	35,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 20.)

21. *Removing sunken vessels or craft obstructing or endangering navigation.*—The passenger steamer *Bay Ridge* burned and sunk in Hempstead Harbor, N. Y., on the night of August 10, 1888. Efforts were made by the owner to have the wreck taken up, but after the contractor stopped working it was found that pieces remained with not over 9 feet depth. Removal of the wreck has been authorized, and the notice to owners has been published; it is expected that a contract for the work will be entered into soon.

(See Appendix D 21.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examination of *Fort Pond Harbor, Montauk, New York*, was made by the local engineer in charge, Lieutenant-Colonel Houston, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers, concurring in the conclusion reached in this instance, has given no instructions to make further survey with a view to its improvement. (See Appendix D 22.)

At the following localities, reported by the local engineer as worthy of improvement, and this conclusion being concurred in by the Chief of Engineers, the result of the preliminary examination containing information sufficient to indicate to Congress the probable cost of the work required, no further report or survey appeared to be necessary:

1. *Black Rock Harbor, for breakwater to Penfield Reef and south from Fairweather Island, Connecticut.*—For this improvement two estimates are submitted, viz: (1) For breakwater extending 4,000 feet nearly south from Fairweather Island, with breakwater extending along Fairfield Bar from the mainland to "the Little Cows," and breakwater extending from "the Little Cows," northwestwardly 1,500 feet long, at a total estimated cost of \$1,025,000. (2) For breakwater 1,500 feet long, nearly south from Fairweather Island, and for dredging 560,000 cubic yards; total estimated cost, \$157,609. The latter estimate is approved. (See Appendix D 23.)

2. *New London Harbor, Connecticut.*—The improvement contemplated is deepening the approaches to the wharves at New London so as to admit vessels of 15 feet draught; estimated cost \$15,000. (See Appendix D 24.)

3. *Mystic River, Connecticut.*—Estimated cost \$30,000, to be applied to dredging. (See Appendix D 25.)

4. *Port Jefferson Inlet, Long Island, New York.*—Two estimates are submitted for this improvement—one contemplating a channel 12 feet deep and 200 feet wide, and providing for repairing and enlarging the east and west jetties; extending the east jetty, and dredging, at an expense of \$145,000, and the other a channel 10 feet deep and 200 feet wide, at a cost of \$90,000. The latter is approved. (See Appendix D 26.)

It appearing from the report of the preliminary examination made by the local engineer that the following localities are worthy of improvement, and the public necessity therefor being apparent from the facts and reasons reported, which are concurred in by the Chief of

Engineers, Colonel Houston was charged with their survey, the results of which will be submitted when received.

1. *Larchmont Harbor, New York.*
2. *Brown's Creek, Saysville, New York.*

IMPROVEMENT OF HUDSON RIVER AND OF HARBORS OF RONDOUT AND SAUGERTIES, NEW YORK—REMOVING OBSTRUCTIONS IN EAST RIVER AND HELL GATE—IMPROVEMENT OF ENTRANCE TO NEW YORK HARBOR—IMPROVEMENT OF RIVERS AND HARBORS IN THE VICINITY OF NEW YORK AND IN NORTHERN NEW JERSEY.

Officer in charge, Lieut. Col. G. L. Gillespie, Corps of Engineers, since January 2, 1889. These works were in charge of Lieut. Col. Walter McFarland, Corps of Engineers, until July 22, 1888; in temporary charge of Capt. George McC. Derby, Corps of Engineers, from July 22, 1888, to January 2, 1889.

1. *Hudson River, New York.*—The improvement of this river has been restricted by the wording of the appropriation acts to that part of it lying between Troy, at the head of navigation, 6 miles above Albany, and New Baltimore, about 14 miles below Albany.

Before the improvement was begun the navigable depth in the channel between New Baltimore and Albany was $7\frac{1}{2}$ feet at mean low water; between Albany and Troy, 4 feet.

The plan of improvement adopted in 1867 proposed making the navigable depth between New Baltimore and Albany 11 feet, and between Albany and Troy 9 feet. This was to be accomplished by the construction of longitudinal dikes to direct the currents, and by dredging.

The estimated cost of making this improvement, prepared in 1882, subject to be increased annually, was \$1,078,304. In 1888 the estimated cost was \$1,314,330.57. The amount expended to June 30, 1888, was \$1,032,137.59, of which sum a large part has, however, from the necessity of the case, been applied to the repair of decaying dikes instead of to the construction of the new dikes yet to be built. At that date the dikes provided for in the project of improvement, so far as built, have resulted in securing a channel depth of 10 feet nearly all the way from New Baltimore to Albany, and of 8 feet nearly all the way from Albany to Troy. The shoal spots make the navigable depths on those parts of the river $9\frac{1}{2}$ feet and $7\frac{1}{2}$ feet respectively.

A close examination of the dikes made in June shows that the estimated cost of the improvement prepared in 1888 must be increased to \$1,424,435 in order to complete the works yet to be built, and to put in good repair those already built.

The amounts appropriated to date are \$1,129,330.57. No expenditures have been made during the year for improvement.

The appropriation of \$75,000, act of August 11, 1888, will be expended under contract in repairing the dikes at those points where the navigation of the channel is most endangered.

The appropriation of \$150,000 which is recommended is designed to continue the improvement by the repair of the various dikes.

July 1, 1888, amount available.....	\$21,458.28
Amount appropriated by act of August 11, 1888.....	75,000.00
	<hr/> 96,458.28
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$1,394.00
July 1, 1889, outstanding liabilities.....	208.00
	<hr/> 1,602.00
July 1, 1889, balance available.....	<hr/> 94,856.28

{ Amount (estimated) required for completion of existing project.....	\$295, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	150, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix E 1.)	

2. *Harbor at Saugerties, New York.*—This harbor is formed by the mouth of Esopus Creek, which empties into the Hudson River, on the West Bank, about 100 miles above New York City.

The bar at entrance at the time of the original examination, made in November, 1883, with the view to preparing estimates for improvement, had a navigable depth of 3 feet only at mean low water, and the distance between the 6-foot curves across it was 1,100 feet. The harbor could therefore be entered only at high water even by the smallest class of vessels.

The plan of improvement which was adopted in 1887 provided for securing a depth of 8 feet mean low water from the entrance to the head of navigation, $1\frac{1}{2}$ miles, by the construction of two parallel dikes, each 2,300 feet long, 260 feet apart on the inside, and 280 feet apart on the outside, and by dredging, if found necessary, 30,000 cubic yards of material from the channel between the dikes.

The estimated cost of the improvement was \$52,000; the amount appropriated to date is \$32,000; the amount expended upon the project up to the close of the fiscal year ending June 30, 1888, was \$13,363.14.

At that date the south dike had been completed, and its length by actual measurement was 2,363½ feet.

The depth on the bar, gained chiefly by dredging done by the State of New York in 1887, was 6 to 7 feet mean low water.

The amount available for the fiscal year ending June 30, 1889, was \$14,698.69.

The amount expended during the fiscal year ending June 30, 1889, was \$1,593.86 (exclusive outstanding liabilities), and was applied in the removal of pile work at the inner end of the south dike and the removal by dredging of 22,646 cubic yards of material from the bar, and the inner shoal opposite Freligh's Wharf. A contract has also been made for the construction of 125 feet of crib-work, and 700 feet of pile-dike in execution of approved project for the construction of the north dike.

The existing navigable depth from the entrance to the head of navigation is 9 feet mean low water in a channel from 100 to 300 feet wide.

The appropriation of \$20,000 recommended for the fiscal year ending June 30, 1891, will be applied in extending eastward the north dike according to the approved project.

July 1, 1888, amount available.....	\$2, 698. 69
Amount appropriated by act of August 11, 1888.....	12, 000. 00
	<hr/> 14, 698. 69
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$1, 593. 86
July 1, 1889, outstanding liabilities.....	2, 528. 21
July 1, 1889, amount covered by existing contracts.....	8, 139. 67
	<hr/> 12, 261. 94
July 1, 1889, balance available.....	<hr/> 2, 436. 75
{ Amount (estimated) required for completion of existing project.....	20, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	20, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix E 2.)	

3. *Harbor at Rondout, New York.*—This harbor is formed by the mouth of Rondout Creek, which empties into the Hudson River on its west side about 90 miles above the city of New York, and is the eastern terminus of the Delaware and Hudson Canal. The creek is a tidal stream for 3 miles above its mouth, and prior to 1871 all improvements had been made by private parties.

The Government made a survey of the harbor in 1869, and the available depth of water then in the channel was only 7 feet at mean low water.

The project of improvement, based on this survey, was for the formation and maintenance of a channel 100 feet wide and 14 feet deep, mean low water, at the mouth of the creek to be obtained by means of dikes and dredging. Two parallel channel-dikes, 350 feet apart at the entrance, were to be built outward, toward, and into the Hudson River, and a branch dike up-stream to protect the north dike against destruction by ice.

The estimated cost of the project was \$172,500.

The project was completed in 1880 at an actual cost of \$90,000 only. At that time the length of the north dike was 2,200 feet, and that of the south dike 2,800 feet, and there was a channel between them 100 feet wide and 13½ feet, mean low water.

The appropriations which have been made since 1880 have been applied exclusively to the repair of the dikes. The amount appropriated to date is \$101,500; the amount available for the fiscal year ending June 30, 1887, was \$5,151.22. The amount expended upon the project and upon repairs up to the close of the fiscal year ending June 30, 1888, was \$96,348.78, at which date the navigable channel was 100 feet wide, and from 12½ to 13½ feet deep, mean low water. The dikes were built originally of timber and stone to the height of mean high water, but the timber has since become so damaged by age and by the ice that the stone filling in many places has fallen out from between the rows of piles, and the height of the dikes has been correspondingly lowered.

It is recommended that the dikes be repaired in the future by the use of stone alone, so that they may be gradually converted into more permanent structures.

The amount expended during the fiscal year ending June 30, 1889, was \$103.51, and was applied in driving piles along both dikes, so that the channel might be better defined while the dikes were submerged. A contract will soon be made to repair both dikes with the available balance, which will be completed in the autumn.

An appropriation of \$10,000 is recommended for application in dredging on the bar at the entrance, repairing the dikes, dredging on inside shoal, and in removing a rocky ledge in mid-channel, opposite Robinson's ship-ways.

July 1, 1888, amount available	\$151.22
Amount appropriated by act of August 11, 1888	5,000.00
	<hr/> 5,151.22
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	103.51
	<hr/> 5,047.71
{ Amount (estimated) required for completion of existing project	25,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix E 3.)	

4. *Harlem River, New York.*—The Harlem River and Spuyten Duyvil Creek are both included in this improvement.

The head of navigation in the former is practically at the High Bridge, about 5 miles from its junction with the East River; in the latter, at King's Bridge, about $1\frac{1}{2}$ miles from the Hudson River, for vessels of 8 feet draught, at high water only.

The object of the improvement is to form a navigable channel between the East and Hudson rivers.

The project for the improvement as originally adopted in 1875 was for a channel 350 feet wide and 15 feet deep at mean low water. In 1879 the project was so far modified as to increase the width of the channel in the Harlem River and Spuyten Duyvil Creek to 400 feet, and retaining the original width of 350 feet, through Dyckman's meadow, but increasing the depth to 18 feet mean low water.

The estimated cost of the work was \$2,700,000.

The amount expended upon the improvement up to the close of the fiscal year ending June 30, 1888, was \$62,179.68, exclusive of outstanding liabilities.

During the fiscal year ending June 30, 1889, there has been expended the sum of \$101,941.37 (exclusive of outstanding liabilities) on the cut through Dyckman's Meadow, for engineering experiments in structures for protecting the sides of the channel and for borings to obtain more detail information as to the depth of the marsh mud, and character of the material overlying the rock in the section of the rock cut through Dyckman's Meadow and in the bed of Spuyten Duyvil Creek. One hundred and forty-two thousand five hundred and forty-four cubic yards only had been removed by the contractor from the cut through Dyckman's Meadow on May 31, 1889, instead of the 300,000 cubic yards called for by the contract, and on his application the time for completion has been extended to May 31, 1890.

The appropriation of August 11, 1888, of \$70,000 will be applied to the construction of a large coffer-dam to protect the cut from the waters of the Harlem River, and to the removal of the material from a small section of the cut adjoining the coffer-dam.

The amount that can be profitably expended during the year ending June 30, 1891, is \$500,000 and would be applied to the completion of the cut through Dyckman's Meadow, to excavating the channel through the marsh between the section of the cut through Dyckman's Meadow now under contract and the Hudson River, and to structures for protecting the sides and probably the bottom of the new channel in many places.

The estimated amount required for the completion of the work according to the approved project is \$2,230,000.

July 1, 1888, amount available (inclusive of amount covered by contract July 1, 1888).....	\$339,544.48
Amount appropriated by act of August 11, 1888.....	70,000.00
	<hr/>
	409,544.48
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$101,941.37
July 1, 1889, outstanding liabilities.....	25,806.60
July 1, 1889, amount covered by existing contracts.....	163,923.71
	<hr/>
	291,671.68
July 1, 1889, balance available.....	<hr/>
	117,872.80

Amount (estimated) required for completion of existing project.....	\$2,230,000.00
Amount that can be profitably expended in fiscal year ending June 30 1891.....	500,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix E 4.)	

5. *Removing obstructions in East River and Hell Gate, New York.*—Hell Gate is the worst obstruction in the narrow strait connecting Long Island Sound with New York Harbor, known as the East River.

At this point the channel turns at right angles around Hallet's Point, opposite the mouth of the Harlem River, and the current runs with a velocity varying at different stages of the tide from 3 to 10 miles an hour over or around Ways Reef, Pot Rock, Shell Drake, Hallet's Point, Negro Point, Holmes' Rock, Hog's Back, Heel Tap, Flood Rock, Hen and Chickens, Gridiron, Mill Rocks, the Negro Heads, Rhinelanders' Reef, and Bread and Cheese.

Besides this most serious obstruction there are many other rocks and reefs in the East River, especially those off the Battery, off Thirty-fourth street and Charlotte Rock, which are dangerous to its crowded navigation, and which ought to be removed.

Originally the channel of East River and Hell Gate contained many large and dangerous rocky obstructions to navigation.

The depth over Diamond Reef at mean low water was 17½ feet; over Coenties Reef, 14.3 feet; over Frying Pan, 11 feet; over Pot Rock, 20 feet; over Heel Tap, 12.1 feet, and over reef at North Brother's Island, 16 feet. Hallet's Point projected from the shore at Astoria under water 325 feet to the contour line of 26 feet at mean low water and embraced an area of about 3 acres. The Middle Reef, with an area of about 9 acres, lay in the middle of the channels at Hell Gate; it had a small backbone projecting above high water, called Flood Rock, upon which vessels were stranded when driven there by the ebb currents which swept directly over the rock.

The project, originally adopted in 1867, provided for the removal of Negro Head, Flood Rock, Hen and Chickens, Gridiron, Pot Rock, Frying Pan, Ways Reef, Shell Drake, the rock off Negro Point, the rocks near Woolsey's Bath House, Blackwell's Rock, portions of Hallet's Point and Scaly Rock, to a depth of 26 feet at mean low water. Sea-walls were designed also for the Middle Reef, Hog's Back, Bread and Cheese, and a beacon for Rhinelanders' Reef. The estimated cost of the project was \$8,692,645.15. The estimate for the project was revised in 1874, and the total estimated cost placed at \$5,139,120, inclusive of the removal of Diamond and Coenties reefs, at a cost of \$449,300.

The amount appropriated to June 30, 1888, was \$3,910,800, and the amount expended thereon up to the close of the fiscal year ending June 30, 1888, was \$3,633,892.91.

At that date Hallet's Point, covering 3 acres, Ways Reef, Shell Drake, Diamond Reef, North Brother's Island Reef, Coenties Reef, Scaly Rock, and Pilgrim Rock had all been removed to the depth contemplated in the project; Heel Tap had been broken to 26 feet, and dredged to 20.5; and the least depths on Pot Rock and Frying Pan were 22.8 and 18 feet at mean low water, respectively; Flood Rock and connecting reefs covering 9 acres had been broken to 30 feet, and about one-fourth of the débris had been removed—the Negro Heads and Hen and Chickens having been reduced to 18 feet mean low water, and a new 18-foot channel, 380 feet wide, opened across the reef.

Sea-walls have been built by the Government on Great and Little Mill rocks, and by the city authorities on Bread and Cheese Reef.

The results have been of the greatest value to navigation. The act of August 11, 1888, appropriated \$250,000 for this work, and under this appropriation the plant of the Atlantic Dredging Company, consisting of two dredges, two scows, one tug, and one water-boat, was purchased for the sum of \$65,500, delivered at Flood Rock, in good working condition, June 24, 1889, and work was commenced by day labor, June 25, 1889. At the close of the fiscal year the plant has removed 1,410 tons of broken stone.

The amount of blasted rock removed by contract from Flood Rock since the great blast of 1885 is 83,097 tons, and by the drill-scow 558 tons; total, 83,685 tons.

The appropriation of August 11, 1888, being sufficiently large to provide for two years' consecutive work for the dredging plant and for six months' work for the United States steam drill-scow, the removal of some of the reefs in the East River will be undertaken, and the drill-scow is being fitted out for work and will begin operations early in July.

An appropriation of \$400,000 is asked to continue work upon Flood Rock, Heel Tap, Frying Pan, and Pot Rock, all within the district of Hell Gate, and to remove the small reef off Hunter's Point at southern entrance to eastern channel around Blackwell's Island, and some of the principal projections from the long shoal on the western side of East River from Grand street to Thirty-fourth street.

No active work was done during the year, and the amount expended, \$7,943.81, has been applied to surveys of the reef, repairs of vessels, care and preservation of the working plant, and rental of grounds for storage of material.

July 1, 1888, amount available.....	\$16,085.16
Amount appropriated by act of August 11, 1888	250,000.00
	<hr/> 266,085.16
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$7,943.81
July 1, 1889, outstanding liabilities.....	67,237.92
	<hr/> 75,181.73
July 1, 1889, balance available.....	190,903.43
{ Amount (estimated) required for completion of existing project.....	1,238,840.67
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	400,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix E 5.)	

6. *Newtown Creek, New York.*—This is a tidal stream about 4 miles long, running through the eastern part of Brooklyn, and emptying into the East River opposite Thirty-fourth street, New York City.

It had formerly a depth of 12½ feet mean low water, at the mouth, gradually decreasing to 4 feet at the head.

The original project for its improvement adopted in 1880, but modified in 1883, provided for a channel 200 feet wide and 18 to 21 feet deep mean low water, extending from the mouth up to Vernon Avenue Bridge, and from that point up to the head of navigation, on both branches, a channel decreasing from 175 feet to 100 feet in width, and from 18 feet to 10 feet in depth, at an estimated cost of \$255,569.

The amount appropriated up to June 30, 1888, was \$82,500, of which amount \$50,750 has been applied from Vernon Avenue Bridge to East

River, and \$31,750 from Covert's Dock to the head of navigation in both branches.

The amount expended up to the close of the fiscal year ending June 30, 1888, was \$80,957.17.

At that date, as shown by a survey made in January, 1889, the channel immediately below Vernon Avenue Bridge, was 100 feet wide and 18 feet deep, and on the bars the width was 75 feet, and 16 feet deep only, mean low water, while at the head of navigation, both branches had shoaled $3\frac{1}{2}$ feet approximately, reducing the depth in the channels there to $6\frac{1}{2}$ feet, mean low water. The intermediate section had slightly deepened though no work had ever been done there.

The amount appropriated by act of August 11, 1888, was \$25,000. The amount expended during the fiscal year ending June 30, 1889, was \$2,046.65, exclusive of outstanding liabilities, and was applied towards office expenses and advertising, and the execution of a contract for dredging 120,000 cubic yards of material in continuation of the approved project, 50,000 cubic yards to be removed below Vernon Avenue Bridge to form a channel 100 feet wide and 20 feet deep, and 70,000 cubic yards from Vernon Avenue Bridge to Queens County Oil Works, to form a channel 75 feet wide and 18 feet deep.

Up to the close of the fiscal year, 7,738 cubic yards of material have been removed between Vernon Avenue Bridge and East River. The bed of the creek in this section, below the plane of 18 feet mean low water, is composed of material which varies greatly in character; near the bar it is composed of sand, or sand and clay mixed, but as the bridge is approached it is composed of hardpan intermixed with large bowlders, and is difficult of removal. Above the bridge the bed is composed of soft mud, in which large bowlders are occasionally found embedded; and the banks are so unstable that no permanent benefit can be derived by dredging until they are retained by secure bulkheads.

The survey made in January, 1889, showed that 568,621 cubic yards was required at that date to be removed to complete the original project of 1880 and the extended project of 1883, at an estimated cost of \$170,586.30, inclusive of the appropriation of \$25,000, act August 11, 1888.

The value of the annual commerce of the creek is estimated at \$50,000,000.

The existing channel is not adequate in width or depth to the demands of this commerce, and the adopted project for improvement should be completed as early as practicable by methods which will carry the improvement progressively from the mouth to the head of navigation.

An appropriation of \$50,000 is recommended, to continue work on the approved project.

July 1, 1888, amount available	\$1,542.83
Amount appropriated by act of August 11, 1888.....	25,000.00
	<hr/> 26,542.83
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$2,046.65
July 1, 1889, outstanding liabilities.....	911.15
July 1, 1889, amount covered by existing contracts.....	20,768.47
	<hr/> 23,726.27
July 1, 1889, balance available.....	2,816.56
	<hr/>
{ Amount (estimated) required for completion of existing project.....	148,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	50,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix E 6.)	

7. *Buttermilk Channel, New York Harbor.*—Buttermilk Channel lies between the city of Brooklyn, N. Y., and Governor's Island, New York Harbor, and is obstructed at its upper end, where it joins the East River, by a shoal, over which there was formerly a least depth of 9½ feet at mean low water. The crest of this shoal lay about 800 feet distant from the line of the Brooklyn wharves.

The original project of improvement, adopted in 1881, provided for the removal to a depth of 26 feet mean low water of such parts of the shoal as came within 850 feet of the Brooklyn wharves, which would take off the crest of the shoal and give elsewhere a depth of not less than 15 feet mean low water.

The estimated cost of the improvement was \$210,000. In view of the increasing importance of the wharves on the Brooklyn shores and the difficulty experienced by deep-draught vessels in getting up to them by reason of this shoal, the project of improvement was modified in 1885 so as to provide for the removal of the entire shoal to a depth of 26 feet mean low water, at an estimated additional cost of \$150,000, making the total estimated cost of the project \$360,000.

The amount appropriated to the close of the fiscal year ending June 30, 1888, was \$246,350, and the total amount expended to same date was \$240,492.84.

At that time the width of the channel adjacent to Brooklyn wharves, in which the depth was 24 feet and over, did not exceed 600 feet, and the water had been deepened over the entire surface of the shoal to 22 feet mean low water, except on the extreme western side, where the average depth was 21 feet only, with a few isolated spots upon which the depth was 19 feet only.

The act of August 11, 1888, appropriated \$100,000 for continuing the improvement.

The amount which was expended during the fiscal year ending June 30, 1889, was \$1,016.17, and was applied towards office expenses and advertising.

No work of improvement was done during the year owing to delays in securing satisfactory bids for the expenditure of the available appropriation.

A contract is now in force for the excavation of 500,000 cubic yards of material in continuation of the project. On its expiration, December 31, 1889, it is believed that the project will be completed and that there will then be 26 feet mean low water over the entire shoal.

No appropriation is recommended for continuing the improvement.

July 1, 1888, amount available	\$5,857. 16
Amount appropriated by act of August 11, 1888	100,000. 00

105,857. 16

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$1,016. 17
July 1, 1889, amount covered by existing contracts	92,500. 00
	<hr/> 93,516. 17

July 1, 1889, balance available	12,340. 99
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(See Appendix E 7.)

8. *Gowanus Bay, New York.*—Gowanus Bay is a part of New York Harbor, lying at the mouth of Gowanus Creek, in the southwestern part of the city of Brooklyn.

The depth of water in the channels of Gowanus Creek and Bay was originally only from 7 to 12 feet at mean low water, which was wholly insufficient for the passage of vessels employed in the commerce of the district.

The plan of improvement adopted in 1881 provided for giving a depth of 18 feet to the channels in the bay leading up to the mouth of the creek on both the north and the south sides, and for carrying the improvement with the same depth up the creek to Hamilton Avenue Bridge, a distance of 1 mile.

The channel widths were to be 200 feet, except for the last few hundred feet up to the bridge, in which distance the width would gradually increase.

The estimated cost of this improvement was \$192,654.90. The amount appropriated to June 30, 1888, was \$72,500.

The amount expended to the close of the fiscal year ending June 30, 1888, was \$72,436.69, and at that date the channel on the north side (Red Hook Channel), running around the Erie Basin to the mouth of the creek, and thence into the creek as far as Court street, had been completed 200 feet wide and 18 feet deep, mean low water, and the Gowanus Creek Channel had been carried to Halleck street, 40 feet wide, and 15 feet deep; and the channel on south side (Bayside Channel) had been completed for the full projected width of 200 feet, and depth of 18 feet, to a point 2,000 feet south of the mouth of the creek. These channel dimensions were regarded too small to accommodate the largest sea-going vessels, and an estimate was made in the annual report for 1888 for enlarging the two former channels, so that they should have each a width of 400 feet where possible, and a depth of 21 feet, mean low water, at an estimated cost of \$600,000.

The act of August 11, 1888, appropriated \$60,000 for continuing the improvement by widening the Red Hook Channel to 400 feet, and deepening it to 21 feet mean low water, from the foot of Percival street to the entrance.

The work was let to contract February 21, 1889, for the removal of 300,000 cubic yards of materials, to open a channel 100 feet wide and 21 feet deep, mean low water, extending from the entrance to the foot of Percival street, and to provide a turning ground for vessels by excavating the triangular slips below and adjacent to the latter point. Work began under the contract April 16, 1889, and up to the close of the fiscal year, 38,938 cubic yards has been removed, and the improved channel has been carried 25 feet wide and 21 feet deep, up to Percival street, Brooklyn.

The wrecks of two canal-boats were removed from the channel by contract in June, 1889, for the gross sum of \$450.

The amount expended during the fiscal year ending June 30, 1889, was \$4,411.66, exclusive of outstanding liabilities, and was applied in the execution of the foregoing works.

An appropriation of \$60,000 is recommended for continuing the project now in progress for widening the Red Hook Channel to 400 feet, and increasing the depth to 21 feet, mean low water, and deepening to 21 feet, mean low water, the Gowanus Creek Channel up to the foot of Percival street, Brooklyn.

July 1, 1888, amount available	\$63. 31
*Amount appropriated by act of August 11, 1888.....	60, 000. 00
	<hr/> 60, 063. 31
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$4, 411. 66
July 1, 1889, outstanding liabilities	3, 826. 66
July 1, 1889, amount covered by existing contracts	48, 296. 47
	<hr/> 56, 534. 79
July 1, 1889, balance available.....	3, 528. 52

{ Amount (estimated) required for completion of existing project..... \$540,000.00
 { Amount that can be profitably expended in fiscal year ending June 30, 1891 60,000.00
 { Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix E 8.)

9. *New York Harbor.*—Before the improvement of the main entrance into New York Harbor was undertaken by the United States, the least depth in mid-channel on the bar was 23.7 feet, at mean low water, and the same depth could be carried across three other shoals between the bar and deep water in the harbor.

A large proportion of the vast commerce of the port which is carried on in vessels of great draught could only cross these shoals at or near high water.

The project for the improvement of Gedney's Channel was approved by the Secretary of War in December, 1884, and its extension to cover the whole of the main entrance to the harbor received his approval December 27, 1886.

It provides for dredging a channel 1,000 feet wide and 30 feet deep at mean low water, from deep water below the Narrows through the Main Ship Channel and Gedney's Channel to deep water outside the bar; maintaining this channel, should it be necessary, either by periodical dredging or by contracting the entrance by the construction of a dike running across the shoals from Coney Island side, with suitable protection for the head of Sandy Hook to prevent its being scoured away by the increased current.

The estimated cost of obtaining the dredged channel is \$1,490,000 for dredging 4,300,000 cubic yards; and the entire cost of the improvement, should the contraction works prove to be necessary, is estimated at between \$5,000,000 and \$6,000,000.

Under this project an extended survey of the lower bay had been made on which the method of improvement was based.

The amount expended upon the entire channel from below the Narrows to the sea, up to June 30, 1888, was \$345,421.10, exclusive of outstanding liabilities.

At that time the channel over the bar in Gedney's Channel was 500 feet wide and 26 feet deep at mean low water, and over the shoal, west of Flynn's Knoll, in the Main Ship Channel it was 500 feet wide and 25.4 feet deep at mean low water.

During the year work has progressed satisfactorily, with three machines by the Joseph Edwards Dredging Company, and one machine by Brainard Brothers. The aggregate number of yards removed by the contractors was 1,394,777 cubic yards, of which number 266,260 cubic yards were removed from Gedney's Channel, 353,179 cubic yards from Bayside Channel, and 775,338 cubic yards from the Main Ship Channel west of Flynn's Knoll.

The amount expended during the fiscal year ending June 30, 1889, was \$335,971.89, exclusive of outstanding liabilities.

As the result of this work a survey made in June, 1889, shows that the channel over the bar in Gedney's Channel is now 500 feet wide, with a least depth of 30 feet at mean low water; in Bayside Channel 1,000 feet wide, with a least depth of 30 feet at mean low water, and in the Main Ship Channel, west of Flynn's Knoll, 350 feet wide and a least depth of 30 feet at mean low water. In the latter channel the 29-foot channel has a width of 500 feet, and in the Bayside Channel the North-west shoal southeast of red buoy has been entirely removed to the depth of 30 feet mean low water.

The amount needed, outside of existing appropriations, to complete existing project by extending northward the improved channel 1,000 feet wide and 30 feet deep, mean low water, to connect with the 30 feet below the Narrows is \$160,000, and this amount could be well expended in the next fiscal year.

July 1, 1888, amount available (inclusive amount covered by contracts July 1, 1888).....	\$544, 110. 95
Amount appropriated by act of August 11, 1888.....	380, 000. 00
	<hr/> 924, 110. 95
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$335, 971. 89
July 1, 1889, outstanding liabilities.....	66, 550. 90
July 1, 1889, amount covered by existing contracts.....	206, 006. 86
	<hr/> 608, 529. 55
July 1, 1889, balance available.....	<hr/> 315, 581. 40

{ Amount (estimated) required for completion of existing project.....	160, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	160, 000. 00
{ Submitted in compliance with requirements of sections 2 of the river and harbor acts of 1866 and 1867.	

(See Appendix E 9.)

10. *Raritan Bay, New Jersey.*—Raritan Bay forms the western part of the large triangular bay inclosed between Sandy Hook, the New Jersey shore, and Staten Island.

The channel undergoing improvement lies to the southeast of Seguine's Point, on the south shore of Staten Island. At the time of the original survey, August, 1880, the least depth on the shoal lying between the 21-foot curve at Seguine's Point and the 21-foot curve at the head of the bay was 14½ feet mean low water. The project of improvement, based upon the survey, provided for a channel across the shoal 300 feet wide and 21 feet deep mean low water at an estimated cost of \$126,500.

The project was modified in 1885, extending the improvement by providing for a channel of equal width and depth over the shoals in the vicinity of Ward's Point, Staten Island, where the original depth was 19 feet mean low water, so as to give a navigable channel 21 feet deep mean low water, up to Perth Amboy, and one 300 feet wide and 15 feet deep, mean low water, from Great Beds Light to South Amboy, where the original depth was 12½ feet, mean low water, at an estimated cost of \$236,000 for the entire work from the beginning, which estimate was again increased in 1888 to \$240,000 to provide for removal of deposits which had taken place in the interval of three years. The amount appropriated to date is \$182,500. The amount expended upon the modified project up to the close of the fiscal year ending June 30, 1888, was \$153,557.15. At that date the channel was 300 feet wide and 21 feet deep, mean low water, from Perth Amboy to the bend at Great Beds Light, and 315 feet wide and 21 feet deep across the crest of the shoal in the channel leading from the bend towards Seguine's Point, but the funds were not sufficient to complete the work.

The channel eastward of Seguine's Point had a depth not exceeding 18 feet, mean low water. The channel leading to South Amboy had not been begun. The amount expended during the fiscal year ending June 30, 1889, was \$610.30 (exclusive outstanding liabilities), for surveying, advertising, and office expenses. A contract is in force for

dredging 120,000 cubic yards of material from the two channels leading to Perth Amboy and South Amboy, the amount of money applicable for expenditure upon the channel leading to South Amboy being limited to \$8,000. Work under the contract will begin in July.

The channel from the deep water at the head of Raritan Bay, past Seguine's Point to Perth Amboy, exceeds 5 miles in length, is crooked, and is subject to constant shoalings. As the amount appropriated, any one year, for the execution of the project was much less than the estimated cost of the improvement, and as the channel excavated under each appropriation was impaired by shoaling in a greater or less degree before work was resumed under the succeeding appropriation, the previous estimates for this improvement have little value and can not be used for determining the amount required for completing the project at this date. The estimated cost for completing the project, if all the required money could be made available at this time, is \$175,375.

A survey was made in July, 1888, along the shoal parts of the channel leading to Perth Amboy, and at that time the channel from Ward's Point eastward to buoy No. 8 was 300 feet wide and 21 feet deep, mean low water; from No. 6 to Prince's Bay the width was the same, and the depth 20 feet mean low water, and from Seguine's Point eastward over the shoal the channel was 18 feet deep only, and the width was irregular, varying from 100 feet to 300 feet.

The channel leading to Perth Amboy should be deepened as early as practicable to 21 feet mean low water, and that to South Amboy to 15 feet mean low water, as the project provides.

An appropriation of \$50,000 is recommended for continuing the project of improvement under the revised estimate.

July 1, 1888, amount available.....	\$1,007.72
Amount appropriated by act of August 11, 1888.....	25,000.00
	<hr/> 26,007.72

July 1, 1889, amount expended during fiscal year, exclusive of	
liabilities outstanding July 1, 1888.....	\$610.30
July 1, 1889, amount covered by existing contracts.....	22,200.00
	<hr/> 22,810.30

July 1, 1889, balance available.....	<hr/> 3,197.42
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{ Amount (estimated) required for completion of existing project.....	175,375.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891.....	50,000.01
{ Submitted in compliance with requirements of sections 2 of the river and harbor acts of 1866 and 1867.	

(See Appendix E 10.)

11. *Removing sunken vessels or craft obstructing or endangering navigation.*—(1) *Steamer Atlas, New York Harbor.*—This steamer was sunk by collision with a ferry-boat October 23, 1888, off Barclay street, New York City. The owners have employed the Merritt Wrecking Company, of New York, to remove the vessel, who are still engaged upon the work. Sealed proposals for removing the vessel were received, after public advertisement, May 4, 1889, and the contract will be awarded to William E. Chapman, the only bidder, should the owners abandon the vessel after an unsuccessful effort to raise her.

(2) Two canal-boats were removed June, 1889, from the Gowanus Channel, under contract with the Atlantic Dredging Company, of New York, for the gross sum of \$450, the expenses being charged to the appropriation for that improvement.

(See Appendix E 11.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examination of *Tarrytown Harbor, New York*, was made by the local engineer in charge, Captain Derby, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers, concurring in the conclusion reached in this instance, has given no instructions to make further survey with the view to its improvement.

(See Appendix E 12.)

The act also provides for an examination or survey *from the pier Lithe [pier line] to the main channel, a distance of about 1,650 feet, and 700 feet north by northeast from Ellis Island for a ship-channel or basin between the deep water of Hudson River and Ellis Island.* This provision of the act is thought to have been complied with in the information submitted in reports on preliminary examination and survey for a *ship-channel between Jersey City and Ellis Island, New York*, which were submitted to Congress at its last session and published in House Ex. Doc. No. 107, Fiftieth Congress, second session.

(See also Appendix E 13.)

It appearing from the report of the preliminary examination made by the local engineer that the following localities are worthy of improvement, and the public necessity therefor being apparent from the facts and reasons reported, which are concurred in by the Chief of Engineers, Lieutenant-Colonel Gillespie was charged with their survey, the results of which will be submitted when received.

1. *Wappinger's Creek, New York, from Wappinger's Falls to its mouth.*
2. *East River, New York, with a view to the removal of a ledge of rocks in the same, from the foot of Broome street to the foot of Twenty-third street, in New York City.*

IMPROVEMENTS OF SHEEPSHEAD AND CANAESIE BAYS, AND SUMPAWANUS INLET, NEW YORK—OF ARTHUR KILL, NEW YORK AND NEW JERSEY—OF CHANNEL BETWEEN STATEN ISLAND AND NEW JERSEY—OF RIVERS IN NORTHERN NEW JERSEY, AND OF THE HARBOR OF KEYPORT.

Officer in charge, Capt. Thos. L. Casey, Corps of Engineers. Division engineer, Col. H. L. Abbot, Corps of Engineers.

1. *Sheepshead Bay, New York, in charge of Lieut. Col. Walter McFarland, Corps of Engineers, until July 22, 1888, after which in temporary charge of Capt. George McC. Derby, Corps of Engineers, until December 6, 1888.*—The original condition of the navigable channel was, for the entrance a depth of a little over 2 feet at mean low water, and for the interior channel not less than 4 feet, except at two narrow bulkheads across said channel.

The originally adopted project (1879) was to deepen the entrance by means of converging jetties, and to improve the interior channel by longitudinal dikes, so placed as in some instances to form tidal reservoirs for the scour of the channel. The project was revised in 1881, and provides for excavating a channel at the outlet 100 feet wide and 6 feet deep at mean low water, to connect the bay with Dead Horse Inlet, and to dredge the interior channel.

The amount expended under the revised project to end of the fiscal year ending June 30, 1888, was \$15,882 44.

An examination made in March, 1889, shows that the channel has been slowly improving since the permanent outlet into Dead Horse Inlet was dredged in 1884-'86. A 5-foot channel over 60 feet wide exists as far as Hog Creek, a distance of 4,500 feet from the entrance.

The expenditures during the fiscal year ending June 30, 1889, amount to \$1,022.41, for surveying, administration, and part purchase of tug-boat.

July 1, 1888, amount available.....	\$5, 117.56
Amount appropriated by act of August 11, 1888.....	5, 000.00
	<hr/> 10, 117.56
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$1, 022.41
July 1, 1889, outstanding liabilities.....	60.75
July 1, 1889, amount covered by existing contracts.....	8, 000.00
	<hr/> 9, 063.16
July 1, 1889, balance available.....	1, 034.40
{ Amount (estimated) required for completion of existing project.....	8, 200.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix F 1.)

2. *Canarsie Bay, New York.*—In charge of Lieut. Col. Walter McFarland, Corps of Engineers, until July 22, 1888, after which in temporary charge of Capt. George McC. Derby, Corps of Engineers, until December 6, 1888. The original condition of the channel leading to Canarsie answered to a depth of 4½ feet mean low water.

The original project adopted in 1879, provides for obtaining a navigable channel 6 feet deep at mean low water from Canarsie Landing to the deep water in Jamaica Bay, by means of diking and the formation of a tidal basin. In the Annual Report of the Chief of Engineers 1880, Part 1, page 574, General Newton expressed doubt as to adequate appropriations being made for carrying out the authorized project, and suggested that dredging be tried as an expedient.

The amount expended to the close of the fiscal year ending June 30, 1888, was \$24,563.63. With this amount a pile-dike 1,058 feet long has been built on the north side of the outer end of the channel, and a channel from 5 to 6 feet deep and from 50 to 125 feet wide has been kept open from the 6 foot curve in Jamaica Bay, to the dock at Canarsie Landing.

There has been expended during the fiscal year ending June 30, 1889, \$16,827.11; with this amount a pile-dike 820 feet long was built on the south side of the channel, and the channel dredged to a depth of 6 feet mean low water, with a width of from 50 to 125 feet from the Canarsie Landing to the deep water in Jamaica Bay, and a cut 100 feet long, 50 feet wide, and 6 feet deep was made on the east side of the steamboat landing at Canarsie for the convenience of the steam-boats in turning.

July 1, 1888, amount available.....	\$46.87
Amount appropriated by act of August 11, 1888.....	10, 000.00
	<hr/> 10, 046.87
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$8, 437.61
July 1, 1889, outstanding liabilities.....	2.00
	<hr/> 8, 439.61
July 1, 1889, balance available.....	1, 607.26

{ Amount (estimated) required for completion of existing project.....	\$45,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix F 2.)

3. *Sumpawamus Inlet, New York*.—In charge of Lieut. Col. Walter McFarland, Corps of Engineers, until July 22, 1888, after which in temporary charge of Capt. George McC. Derby, Corps of Engineers, until December 6, 1888. The channel depth at the time of the adoption of the project varied from 5 feet in the bay at mean low water to 2 feet at the wharf at the mouth of the creek, a distance of a little over half a mile.

The project for the improvement of this inlet, known locally as Sumpawams Creek, adopted in 1880, provided for dredging a channel about 4,500 feet long, and from 100 to 150 feet wide and 5 feet deep at mean low water, beginning at the 5-foot curve in the Great South Bay and extending up to the town of Babylon, Long Island.

The amount expended under this project to June 30, 1888, was \$6,928.12, with which a channel 75 feet wide and 5 feet deep from the steam-boat wharf to a point 750 feet below it, was dredged, besides dredging two cuts, each 25 feet wide, alongside of the wharf.

Outside of the cuts so made and extending to the 5-foot curve in the bay a shoal was left, on which the depth was only about 4½ feet.

An examination made in 1886 showed that since the last dredging was done, in 1883, both the cut and the flat outside had shoaled from 6 inches to 1 foot, the depth in the cut being about 5 feet, while on the flat it was from 4 to 4½ feet. This was to have been anticipated, as appears by the preliminary report made by General Newton. The 5-foot curve in the bay was about 1,500 feet from the steam-boat wharf, but inside this curve, for about 750 feet, towards the wharf, lay the flat.

The commerce of Sumpawams Creek is essentially that of Babylon, a small town of from 3,000 to 5,000 inhabitants, one mile above the mouth of the creek, depending almost entirely upon the summer trade of the hotels and cottages along the north shore of Great South Bay and on Fire Island Beach.

The commerce of Babylon by water has been decreasing, apparently because the Long Island Railroad has taken away the sea-going business. Babylon itself has improved, and has become a fashionable summer resort. At present its commerce by sea is carried on by three passenger steam-boats, drawing from 4 to 5 feet, and running in summer to Fire Island Beach; three schooners, drawing from 5 to 5½ feet, carrying brick, lime, lumber, and other heavy freight to Babylon the year round; 100 sloops and pleasure-boats, drawing from 1 to 2 feet of water, taking out sailing and fishing parties during the summer, of which seven or eight remain in use during the winter, fishing and taking oysters and clams to Patchogue, Sayville, and New York.

The expenditures during the fiscal year ending June 30, 1889, amount to \$54.75, for office expenses.

July 1, 1888, amount available.....	\$71.88
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	54.75
July 1, 1889, balance available.....	17.13

{ Amount (estimated) required for completion of existing project.....	16,115.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix F 3.)

4. *Arthur Kill, New York and New Jersey.*—This is a new work, the appropriation for which, amounting to \$10,000, is in the act of August 11, 1888.

The improvement consists for the present entirely in the removal of a point of land near and to the south of the Staten Island Bridge, for the purpose of straightening the channel, in order that the currents may be directed more truly in a direction perpendicular to the draw-span of the bridge, thus facilitating the passage of long tows.

Certain legal difficulties have presented themselves, involving the purchase of the land in question, and the matter has been placed in the hands of the United States district attorney.

At the close of the fiscal year no agreement had been reached, although it was thought that a final adjustment would be obtained by condemnation in about two weeks. Upon the completion of the legal proceedings it is the intention to proceed with the work of improvement immediately.

The expenditures during the fiscal year amount to \$974.35, for administration and part purchase price of tug-boat.

Amount appropriated by act of August 11, 1888	\$10,000. 00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	974. 35
July 1, 1889, balance available.....	9,025. 65

{ Amount (estimated) required for completion of existing project.....	16,500. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	16,500. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix F 4.)

5. *Channel between Staten Island and New Jersey, in charge of Lieut. Col. Walter McFarland, Corps of Engineers, until July 22, 1888, after which in temporary charge of Capt. George McC. Derby, Corps of Engineers, until December 6, 1888.*—Before this improvement was undertaken by the United States there was a navigable channel having a minimum depth of 9.2 feet from the deep water in Newark Bay to Elizabethport.

The original project for this improvement provided for obtaining, by means of dredging and a system of training-dikes, of a channel north of Shooter's Island 6,500 feet long, 150 feet wide, and 16 feet deep at mean low water.

Under this project 2,237 feet of dike was built. Owing to the opposition mainly of the company engaged in the transportation of freight through the Delaware and Raritan Canal a resolution was passed by the legislature of the State of New York January 22, 1875, protesting against the projected method of improvement. Presumably in consequence of these resolutions, a Board of Engineers, appointed under section 3, act of March 3, 1875, to examine and report upon a plan for the improvement of the channel, convened at New York City May 12, 1875, and on November 20, 1875, submitted to the Chief of Engineers a report recommending that a channel 11 feet deep and 500 feet wide be dredged along the general lines of the existing channel. The project was again modified in 1880, so as to obtain a channel 400 feet wide and 13 feet deep over the middle 200 feet and 12 feet deep on the outer 100 feet on each side; and, in addition, if found necessary, dikes were to be built on the opposite sides of the channel. Subsequently it was decided to give the channel 13 feet depth for its full width of 400 feet.

The amount expended to June 30, 1888, was \$168,189.40. In its present condition the channel possesses depths of from 13 to 20.7 feet,

mean low water, throughout its length through widths varying from 160 to 350 feet, the narrowest portion being at the bend at the Stake Light, where it appears to be least stable.

No work has been done during the fiscal year, with the exception of office work and surveying.

The expenditures for the fiscal year amount to \$2,123.33, for surveying, part purchase of tug-boat, and office expenses.

July 1, 1888, amount available.....	\$810.60
Amount appropriated by act of August 11, 1888.....	15,000.00

15,810.60

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$2,123.33
July 1, 1889, outstanding liabilities.....	74.62
July 1, 1889, amount covered by existing contracts.....	12,000.00

14,197.95

July 1, 1889, balance available.....	1,612.65
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{ Amount (estimated) required for completion of existing project.....	76,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	30,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix F 5.)

6. *Passaic River, New Jersey, in charge of Capt. George McC. Derby, Corps of Engineers, until December 6, 1888.*—This river is being improved under two separate projects, the first applying to the river above Centre Street or Pennsylvania Railroad Bridge, Newark, as far as Passaic, a distance of 8 miles, and the second to the lower course of the river, from the Centre Street Bridge to beyond the shoals in Newark Bay, a distance of $7\frac{1}{2}$ miles.

1. *Above Newark.*—Before its improvement was undertaken, the upper part of the river had a navigable 6-foot channel, except at Middle, Belleville, Rutherford Park, and Holzman's bars, where the depths were 4.5 feet, 3.9 feet, 3 feet, and 3.5 feet, respectively.

The project of improvement was adopted in 1872, and provided for a channel across the above shoals from $7\frac{1}{2}$ to 6 feet deep at mean low water, and from 200 to 50 feet wide, to be obtained by dredging and diking, at a cost of \$123,924. It was modified in 1885 by extending the channel below Middle Bar 1,500 feet to the Erie Railroad Bridge, increasing the estimate to \$129,000.

Under this project \$124,107.54 had been expended to June 30, 1888, and channels of the required depth had been dredged from 60 to 75 feet wide, excepting for a distance of 1,500 feet above the Erie Railroad Bridge.

There has been no work done on the upper river during the fiscal year, the necessary dredging plant for doing the work purchased in accordance with the approved project for the expenditure of the allotment of \$7,500, made in the act of August 11, 1888, not having been delivered until May 13, 1889. The condition of the river remains unchanged.

The commerce of the upper part of the river was valued in 1884 at \$1,032,000, and returns representing less than one-half of the firms along the river show for the year 1887 a commerce valued at \$721,119. The number of vessels passing the Centre Street Draw-bridge during the year 1888 was 10,773, compared with 10,040 in 1887, and 6,271 in 1879.

The expenditures during the fiscal year, amounting to \$3,708.92, have been for part purchase of dredging plant and office expenses.

July 1, 1888, amount available.....	\$2, 142. 46
Amount appropriated by act of August 11, 1888.....	7, 500. 00
	<hr/>
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	9, 642. 46
	3, 708. 92
	<hr/>
July 1, 1889, balance available	5, 933. 54
	<hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	9, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix F 6.)	

2. *Below Newark.*—The lower portion of the river from Centre Street Bridge to Newark Bay was first surveyed by the Engineer Department in 1879. The greatest depth in the channel, at a point above the Elbow Beacon, was only 7.1 feet, and in many places the greatest depth was 7.5 feet at mean low water.

A project was adopted, based on this survey, providing for obtaining by diking and dredging a channel 200 feet wide and 10 feet deep at mean low water from the Centre Street Bridge to Newark Bay, at a cost of \$232,875.

This project was modified in 1884, pursuant to the river and harbor act of that year, providing for extending the dike at the mouth of the river into the bay, a distance of 8,000 feet, and for dredging a channel across the shoal in Newark Bay 200 feet wide and 10 feet deep at mean low water, increasing the original estimate to \$353,875.

June 30, 1888, \$168,707.85, exclusive of outstanding liabilities, had been expended under this project, the dike at the mouth had been extended about 2,200 feet, making a total length of 6,205 feet. The channel through the shoal in the bay had been dredged to the required dimensions, as also the channel up the river as far as the Newark and New York Railroad Bridge. The remainder of the distance to the Centre Street Bridge, the 10-foot channel had only been dredged from 130 to 100 feet in width. These results had been of very great benefit to the large commerce of the river, which was estimated in 1884 at 1,200,000 tons, valued at \$30,000,000.

There has been no work done on the lower river during the fiscal year, the necessary dredging plant for doing the work, purchased in accordance with the approved project for the expenditure of the appropriation of \$27,500 made in the act of August, 11, 1888, not having been delivered until May 13, 1889.

The condition of the river remains unchanged, the channel is maintaining itself, and no complaints have been received during the year.

The expenditures during the fiscal year, amounting to \$12,429.99, have been for the part purchase of dredging plant and administration.

July 1, 1888, amount available	\$3, 113. 15
Amount appropriated by act of August 11, 1888.....	27, 500. 00
	<hr/>
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	30, 613. 15
July 1, 1889, outstanding liabilities.....	\$12, 250. 99
	92. 63
	<hr/>
	12, 343. 62
July 1, 1889, balance available.....	<hr/>
	18, 269. 53

{ Amount (estimated) required for completion of existing project.....	\$154, 375, 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891.	60, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix F 6.)	

7. *Elizabeth River, New Jersey, in charge of Capt. George McC. Derby, Corps of Engineers, until December 6, 1888.*—This stream, which is 2½ miles in length from its mouth to the head of navigation at Broad street, Elizabeth, has a width of from 50 to 90 feet, and before its improvement the wharves in the city could only be reached at high water by vessels drawing less than 4 feet; its commerce was estimated at 45,000 tons annually. The range of the tide was about 4.7 feet at its mouth, and 3.4 feet at Bridge street.

The project for the improvement was adopted in 1878, and provides for obtaining, by dredging, a channel 60 feet wide and 7 feet deep at high water from the mouth of the river to the head of navigation, at an estimated cost of \$25,530.

The amount expended under this project to June 30, 1888, was \$26,721.74, and a channel had been dredged to the required depth to within 1,000 feet of the Broad Street Bridge. A slight increase in the commerce of the stream had been observed.

There has been no appropriation for this work since 1882. The condition of the river has deteriorated since work was suspended. When last examined vessels drawing 5 feet could ascend the river to the head of the dredged channel at high tide. The commerce of the river is about 30,000 tons, but no substantial increase can be expected while the river remains in its present condition. A coal-yard established in 1887 is doing a business of about 6,000 tons annually.

The city of Elizabeth has a population of about 33,000, and does an active commerce over two important lines of railroad, a considerable portion of which would take the water route, to great advantage, if adequate facilities existed. It is stated that the establishment of the coal-yard on the river has reduced the retail price of coal 50 cents per ton.

The expenditures for the fiscal year amount to \$179.11 for office expenses.

July 1, 1888, amount available	\$278. 26
July 1, 1889, amount expended during fiscal year, exclusive of	
outstanding liabilities July 1, 1888	\$179. 11
July 1, 1889, outstanding liabilities	23. 40
	<hr/> 202. 51
July 1, 1889, balance available	75. 75

{ Amount (estimated) required for completion of existing project.....	16, 160. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix F 7.)

8. *Rahway River, New Jersey, in charge of Capt. George McC. Derby, Corps of Engineers, until December 6, 1888.*—In its original condition the Rahway River had a depth of 8 feet and more at mean high water from its mouth to Bricktown, 3½ miles; 7 feet to Edgar's Dock, 4½ miles; 4.4 feet to Milton Avenue Bridge, 4¾ miles; and 4 feet to Main Street Bridge, 5 miles, in the town of Rahway. Its commerce was estimated at 120,000 tons, and three attempts had been made to establish a line of steam-boats on the river, but had failed on account of the bad condition of the stream.

The original project for its improvement was adopted in 1878, and provided for dredging a channel 125 feet wide and 8 feet deep at high water from Bricktown to Milton Avenue Bridge, and 100 feet wide from that point to Main Street Bridge. The tide rises about 5 feet at the mouth and 4 feet at the head of navigation.

June 30, 1888, \$36,932.33 had been expended under this project, which had resulted in the formation of a channel 7 feet deep at high water, and from 100 to 50 feet in width to within 550 feet of the head of navigation. It has, however, not proved permanent.

The commerce of the river had not increased, though freight rates to Rahway had been materially reduced as a result of the improvement of the river.

There has been no appropriation for this work since 1882.

The expenditures for the fiscal year amount to \$60.37 for office expenses.

July 1, 1888, amount available	\$67. 67
July 1, 1889, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1888.....	60. 37

July 1, 1889, balance available	7. 30
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{ Amount (estimated) required for completion of existing project.....	29,250. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix F 8.)

9. *Raritan River, New Jersey, in charge of Capt. George McC. Derby, Corps of Engineers, until December 6, 1888.*—Before its improvement by the United States the Raritan River had a depth of 8.5 feet at "The Stakes," 3 miles; of 6.5 feet at the "Middle Grounds," $4\frac{1}{2}$ miles; of 7.5 feet at Whitehead's Sand Dock, $8\frac{1}{2}$ miles; and between this point and New Brunswick, $12\frac{1}{2}$ miles above the mouth, the channel was obstructed by a number of rocky shoals with depths of from 8.4 to 6.9 feet at mean low water. The city of New Brunswick and the Delaware and Raritan Canal, which terminates here, together with extensive brick-yards on the South River, did a large commerce on the stream, estimated in 1871 at 3,053,857 tons per annum.

The present project was adopted in 1874, and provides for obtaining by diking and dredging, and where necessary by drilling and blasting rock, a channel 200 feet wide and 10 feet deep at mean low water, from the mouth to New Brunswick, at a cost of \$2,093,662.05. It was modified in 1881 pursuant to the river and harbor act of March 3 of that year by adding to it the dredging of the South Channel, about 13,000 feet long, 100 feet wide, and $5\frac{1}{2}$ feet deep at mean low water, from Kearney's Dock to Crab Island.

Under this project \$456,674.58 had been expended June 30, 1888, in construction of the dikes required by the project at "The Stakes" and "Middle Grounds," in dredging channels 200 feet wide and 12 feet deep at mean low water at these points, and in blasting and dredging a channel of the same dimensions across the rocky shoal at Whitehead's Sand Dock, and in dredging shoal below Martin's Dock to a depth of 10 feet, mean low water, and width of from 25 to 75 feet. Under the two special allotments made for it in the acts of March 3, 1881, and August 2, 1882, the south channel was dredged to the required depth for a distance of 4,000 feet. These improvements have been a great benefit to navigation, permitting the large tows in use on the river to reach a point 4 miles below New Brunswick at all stages of the tide.

The expenditures during the fiscal year amounted to \$35,858.22

The channel from above Whitehead's Sand Dock to Martin's Dock has been dredged to a depth of 10 feet, mean low water, and width of 100 feet, giving a continuous 10-foot channel, 100 feet wide, to within 1½ miles of New Brunswick. The construction of a dike at the "Middle Grounds" with the dredged material, the projected length of which is 3,260 feet, has been begun. The dredging of a channel from Acken's Wharf, 575 feet long, 50 feet wide, and 6 feet deep, was completed.

A dredging plant consisting of one dipper-dredge, three dump-scows, and one tug-boat has been purchased and paid for, and necessary repairs made to the steamer *Star*.

July 1, 1888, amount available.....	\$14,571.86
Amount appropriated by act of August 11, 1888.....	50,000.00
	<hr/> 64,571.86
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$35,672.66
July 1, 1889, outstanding liabilities.....	1,185.61
	<hr/> 36,858.27
July 1, 1889, balance available.....	<hr/> 27,713.59
{ Amount (estimated) required for completion of existing project.....	1,572,412.05
{ Amount that can be profitably expended in fiscal year ending June 30, 1891.....	100,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix F 9.)	

10. *South River, New Jersey, in charge of Capt. George McC. Derby, Corps of Engineers, until December 6, 1888.*—Before the improvement of this stream was undertaken by the United States, the navigation of the lower 2½ miles of its course had been abandoned and a canal dredged at private expense from a short distance below Washington to Sayreville on the Raritan River. In 1880, when the present project for improving the river was adopted, the mouth of this canal, on account of its faulty location, had shoaled to a depth of 4.6 feet at mean low water, and the best depth in the canal, some distance above, had decreased to 3.3 feet. Above Washington a depth of 2.7 feet existed to Bissett's, 3½ miles, and of 2.5 feet to Old Bridge, the head of navigation, 6¼ miles above the mouth of the canal at Sayreville.

The present project, adopted in 1880, provides for closing the river below the head of the canal, correcting the direction of the mouth of the latter, and obtaining by diking and dredging a depth of 8 feet, mean low water, to Washington, 6 feet to Bissett's, and 4 feet to Old Bridge, straightening the channel at two points by cutting across the meadow; it was estimated to cost \$194,695.

The amount expended under this project to June 30, 1888, was \$60,738.40, with which the direction of the mouth of the canal had been changed, the dikes below Washington completed, and a small amount of dredging done on the shoal above Washington. A shoal at the mouth of Washington Canal has been removed and a channel dredged 60 feet wide through the canal and 50 feet wide across the shoal in the river below Washington. Vessels drawing 6 feet can reach Washington at mean low water.

There has been no work done during the fiscal year, the necessary dredging plant for doing the work, purchased in accordance with the approved project for the expenditure of the appropriation of \$5,000 in the act of August 11, 1888, not having been delivered until May 13, 1889.

The condition of the river remains unchanged. The commerce of the river was valued in 1887 at \$872,778. There has been a slight increase

in the export of brick during the past year, two new brick-yards being in operation.

The expenditures during the fiscal year amounting to \$2,759.75 have been for part purchase of dredging plant and office expenses.

July 1, 1888, amount available.....	\$291. 66
Amount appropriated by act of August 11, 1888.....	5, 000. 00
	<hr/> 5, 291. 66

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$2, 759. 75
July 1, 1889, outstanding liabilities.....	277. 66
	<hr/> 3, 037. 41

July 1, 1889, balance available.....	<hr/> 2, 254. 25
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{ Amount (estimated) required for completion of existing project.....	128, 695. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1887.	

(See Appendix F 10.)

11. *Shrewsbury River, New Jersey, in charge of Capt. George McC. Derby, Corps of Engineers, until December 6, 1888.*—When the present project for this improvement was adopted in 1879, the river was obstructed by a number of shifting sand-bars which had caused the complete suspension of navigation in the South Branch, and only permitted the passage of vessels engaged in commerce up the North Branch at or near high water. A considerable trade was carried on, however, even under these difficult conditions.

The originally adopted project for the improvement was to dredge a channel 6 feet deep at mean low water, and from 300 to 150 feet in width across the shoals from the mouth to Red Bank, on the North Branch, 8 miles, and Branchport on the South Branch, 9 miles; maintaining these channels by longitudinal dikes. This project has not been modified as to the end sought, but estimates of the diking, dredging, and cost, have been increased from time to time.

The amount expended on the project to June 30, 1888, was \$200,128.58, exclusive of existing contracts, which had resulted in the material improvement of the river, the commerce of which had been more than trebled since the commencement of the improvement.

The amount expended during the fiscal year ending June 30, 1889, was \$10,104.87, with which dike C 4, 1,260 feet long, has been built to the height of extreme low water, and 4 feet wide on top, except for a distance of 30 feet at its junction with dike C, where it was only raised 2 feet below mean low water to permit the passage of row-boats. Diike C 3 has been built to the height of 1 foot above mean low water, and from 4 to 6 feet wide on top, and the cross-over channel at Upper Rocky Point dredged to a depth of 7 feet, mean low water, for a width of 100 feet by the dredging plant purchased by the United States during the fiscal year.

The amount paid by this improvement for its pro rata share of the dredging plant was \$4,339.

July 1, 1888, amount available.....	\$1, 354. 12
Amount appropriated by act of August 11, 1888.....	10, 000. 00
	<hr/> 11, 354. 12

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$7, 087. 57
July 1, 1889, outstanding liabilities.....	998. 72
	<hr/> 8, 086. 29

July 1, 1889, balance available	<hr/> 3, 267. 83
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{ Amount (estimated) required for completion of existing project	\$40,062.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	20,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix F 11.)

12. *Keyport Harbor, New Jersey, in charge of Capt. George McC. Derby, Corps of Engineers, until December 6, 1888.*—Keyport Harbor was originally accessible at low water only to vessels drawing less than 4 feet. Before its improvement was undertaken by the United States a 6-foot channel had been dredged at private expense, which had shoaled in 1872 to 5½ feet, and in 1882 to 5 feet, the range of the tide being 4.7 feet. A large commerce was carried on, however, valued at \$2,932,000.

The project for the improvement was adopted in 1873, and provided for dredging a channel 4,700 feet long, 8 feet deep at mean low water, and 200 feet wide from the steam-boat dock to the 8-foot contour in Raritan Bay, at an estimated cost of \$30,475. The revised estimate of 1884 was \$40,475.

The amount expended under this project to June 30, 1888, was \$30,042.89, with which a channel had been dredged from the 8-foot depth in Raritan Bay to Keyport Wharf, a distance of 5,000 feet, with a width of 200 feet for the first 4,200 feet and 160 feet for the remainder.

The river and harbor act of 1888 made no appropriation for this work.

The expenditures for the fiscal year amount to \$290.83 for office expenses.

July 1, 1888, amount available	\$427.11
July 1, 1889, amount expended during fiscal year exclusive of liabilities outstanding July 1, 1888.....	\$285.83
July 1, 1889, outstanding liabilities.....	69.60
	<hr/>
	355.43
July 1, 1889, balance available	<hr/>
	71.68

{ Amount (estimated) required for completion of existing project.....	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix F 12.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examination of *East Rockaway Creek, New York*, was made by the local engineer in charge, Captain Derby, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers, concurring in the conclusion reached in this instance, has given no instructions to make further survey with the view to its improvement. (See Appendix F 13.)

It appearing from the report of the preliminary examination made by the local engineer that *Hackensack River, New Jersey, from the lower bridge at the town of Hackensack to the Erie Railway Bridge*, is worthy of improvement, and the public necessity therefor being apparent from the facts and reasons reported, which are concurred in by the Chief of Engineers, Captain Casey was charged with its survey, the results of which will be found in Appendix F 14.

IMPROVEMENT OF DELAWARE AND SCHUYLKILL RIVERS, AND OF RIVERS IN NEW JERSEY—HARBOR IMPROVEMENTS IN DELAWARE RIVER AND BAY—CONSTRUCTION OF PIER AT LEWES—DELAWARE BREAKWATER.

Officer in charge, Lieut. Col. Henry M. Roberts, Corps of Engineers.

1. *Delaware River, Pennsylvania and New Jersey.*—Trenton, the head of natural navigation on the Delaware River, is about 30 miles above the upper part of the port of Philadelphia. In its original condition this part of the river was obstructed by shoals at the following localities: Between Bordentown and Trenton, a distance of about 5 miles, a narrow and circuitous channel existed, which carried from 3 to 6 feet at mean low water; at Kinkora Bar, about 9 miles below Trenton, a shoal carrying from 7 to 8 feet, and at Five Mile Bar, at the upper part of Philadelphia, a shoal across the Pennsylvania channel carrying only 3 or 4 feet at mean low water, there being however 13 feet of water past Five Mile Bar in the New Jersey channel passing south of Petty's Island.

Below Philadelphia the river in its original condition presented obstructions at Mifflin Bar which reduced the depth at mean low water to 17 feet, at Schooner Ledge and Cherry Island Flats to 18 feet, at Bulkhead Shoals and Dan Baker Shoal to about 20 feet.

The project for the comprehensive improvement of the Delaware River between Trenton and the upper part of Philadelphia has not yet been considered. Efforts in the past have been directed toward relieving commerce from the obstructions which exist in the upper 9 miles of the river, or that part between Kinkora Bar and Trenton. A detailed survey of the river between Bridesburg and Trenton has been made for the purpose of obtaining the necessary data for determining upon a comprehensive plan for the permanent improvement of the river between Trenton and the upper part of Philadelphia to meet the requirements of commerce, and also of the plan adopted for the improvement of the river at and below Philadelphia.

Previous to 1885 the efforts to improve the river between Philadelphia and the bay have been confined to dredging, except at Schooner Ledge, where solid rock has been removed, under appropriations for special localities, and also under general appropriations for the Delaware River below Bridesburg.

A Board of Engineers, convened by direction of the Secretary of War for the purpose of considering the subject of the permanent improvement of Delaware River and Bay, recommended, under date of January 23, 1885, the formation of a ship-channel from a point opposite Philadelphia, and about midway between the American Shipbuilding Company's yard and the Gas Trust Wharf to deep water in Delaware Bay, having a least width of 600 feet and a depth of 26 feet at mean low water. The formation of such a channel is to be obtained, except at Schooner Ledge, where rock would require to be removed, by regulating the tidal flow by means of dikes, with recourse to dredging where necessary as an aid to such contracting and regulating works. The estimated cost of obtaining a channel of the above dimensions is about \$2,425,000, which covers the estimated cost of the permanent improvement of the Delaware River between the upper part of Philadelphia and deep water in the bay. The entire cost of the permanent improvement of the river between Trenton, N. J., and its mouth can not be stated until after the completion of the project and estimate for its improvement between Bridesburg and Trenton.

The entire amount expended on the improvement of the Delaware River from 1836 to June 30, 1888, under appropriations both for special localities and the general river, was \$1,691,564.89, of which \$103,494.67 was expended on that part of the river between Trenton and the upper part of Philadelphia. As a result of this expenditure there had been formed at the latter date a channel of navigable width and $7\frac{1}{2}$ feet deep at mean low water through the bars between Bridesburg and Bordentown; a channel across Five Mile Bar 7 feet deep, and past the bar, between its south side and Petty's Island, a channel 9 feet deep; a channel 450 feet wide and from 24 to 26 feet deep through the shoal areas at Port Richmond; a channel across Mifflin Bar 250 feet wide and from $22\frac{1}{2}$ to 23 feet deep; a channel through Schooner Ledge 330 feet wide and 24 feet deep, except over a small area recently discovered, where the depth is reduced to 23 feet at mean low water; a channel through Cherry Island Flats from 200 to 450 feet wide and from 24 to 26 feet deep, and a channel across Bulkhead Shoal 600 feet wide and from 20 to 21 feet deep.

The channel between Philadelphia and Camden, across Smith's Island Bar, had been improved by the formation of a dredged cut protected by revetment, so as to give a channel 150 feet wide with a minimum depth of $6\frac{1}{2}$ feet at mean low water.

During the fiscal year ending June 30, 1889, the sum of \$134,309.27, which includes the liabilities outstanding June 30, 1888, was expended in surveys, examinations, and tidal observations; in dike construction at Five Mile Bar, Mifflin Bar, and Reedy Island, in dredging at Port Richmond, Mifflin Bar, and Bulkhead Shoal, and rock removal at Schooner Ledge and near Otis Street Wharf, Philadelphia, making a total expenditure since 1836 of \$1,825,874.16, of which \$473,874.16 has been expended on present project.

At Five Mile Bar a channel about 200 feet wide and 8 feet deep at mean low water exists, which is the result of the action of the dike in progress of construction between Fisher's Point and Petty's Island. The extension of the dike both in length and height, which has been in progress during the latter part of the fiscal year, is expected to increase the depth of the present 8-foot channel over Five Mile Bar.

At Port Richmond the extension of the 26-foot low-water channel has been in progress by dredging, and at the close of the fiscal year the previously dredged channel, 450 feet wide, had been extended for a width of about 75 feet to a point about 1,500 feet above its upper termination in the previous fiscal year.

At the foot of Otis street, in the city of Philadelphia, where rock in place occurs, drilling and blasting, in preparation for the removal of the rock, has been in progress.

The dike at Mifflin Bar has been completed to the plane of mean low water, except for a gap of 400 feet, which serves as an entrance to the dumping basin, and its action upon the channel dredged through the bar in the fall of 1888, shows that the effect of the dike, though manifest upon the bar, will probably have to be increased by raising the dike in the future to a greater height above the plane of mean low water. The dredged channel across the bar now carries a depth of from 26 to 28 feet at mean low water in a channel from 150 to 100 feet wide.

At Schooner Ledge a quantity of detached rock was found, which reduced the low-water depth in the previously excavated channel to about $22\frac{1}{2}$ feet. These rocks were removed to a depth of 24 feet, except over a quite limited area, where solid rock exists at a depth of 23 feet.

At Bulkhead Shoal a channel 200 feet wide and 24 feet deep at mean low water was excavated across the worst part of the shoal in the fall of 1888. This channel was dredged for the temporary relief of commerce, since the permanent improvement of the shoal can not be expected until the dike is constructed, which is proposed for the improvement of this locality.

The dike at Reedy Island, which is intended for the improvement of Dan Baker Shoal, has not yet reached an extension sufficient to affect the areas it was designed to improve.

The channel at Cherry Island Flats has remained unchanged during the year.

July 1, 1888, amount available	\$26, 034. 49
July 1, 1888, amount covered by existing contracts.....	36, 205. 04
Amount appropriated by act of August 11, 1888.....	250, 000. 00
	<hr/> 312, 239. 53

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$126, 113. 69
July 1, 1889, outstanding liabilities.....	3, 003. 64
July 1, 1889, amount covered by existing contracts.....	83, 063. 33
	<hr/> 212, 180. 66

July 1, 1889, balance available	100, 058. 87
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Amount (estimated) required for completion of existing project	1, 965, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1891	500, 000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix G 1.)

2. *Philadelphia Harbor, removal of Smith's Island and Windmill Island, Pennsylvania, and Petty's Island, New Jersey.*—This is a new work. In obedience to the requirements of the joint resolution of Congress, approved March 5, 1888, a Board of three engineers was appointed by the War Department "to examine and report in relation to the Delaware River between the city of Philadelphia, Pennsylvania, and Camden, New Jersey, and for other purposes," and its report was transmitted to Congress April 7, 1888, and printed as House Ex. Doc. No. 260, Fiftieth Congress, first session.

The plan of improvement proposed by the Board is the forming of a channel along the Philadelphia shore from Kaighn's Point to Fisher's Point, of ample depth and about 2,000 feet in width, at a distance from the present wharf-line not exceeding 300 feet, to permit the extension of wharves and the widening of Delaware avenue at their shore ends, the removal of Smith's and Windmill islands and adjacent shoals, so as to give a 26-foot channel, about 1,000 feet wide, along the revised Philadelphia channel from Kaighn's Point to the head of Petty's Island. The estimated cost of the work is \$3,500,000.

The river and harbor act of August 11, 1888, appropriated \$500,000 for the work, of which not to exceed \$300,000 is to be applied to the purchase of the islands.

During the fiscal year proceedings have been in progress by the Department of Justice for the condemnation of the private property to be taken in carrying into effect the proposed improvement. Smith's and Windmill islands have been appraised at \$484,000 by the jury appointed by the United States circuit court. The difficulties connected with the investigation of the titles to the various properties required on Petty's Island have delayed action upon those cases. The State of

Pennsylvania has appropriated \$200,000 towards the purchase of the islands, and it is believed the balance required will be forthcoming when the amount is known.

A Board of three Engineer officers, the same that constituted the Board that reported the plan for improving Philadelphia Harbor, was appointed February 25, 1880, to establish harbor lines for the port of Philadelphia. This Board has met but has not yet completed its duties.

Amount appropriated by act of August 11, 1888, \$500,000, of which \$300,000 is for purchase of the islands, leaving available for project.. \$200,000.00
 July 1, 1889, balance available..... 200,000.00

{ Amount (estimated) required for completion of existing project.....	3,300,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	500,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix G 2.)

3. *Schuylkill River, Pennsylvania.*—When the work of improvement was commenced in 1870 there was a channel of entrance into the mouth of the river carrying a depth of only 15 feet at mean low water.

The original project under which work was commenced in 1870 proposed the formation of a channel 100 feet wide with a depth of 20 feet from the mouth of the river to Gibson's Point, about 4 miles, and a depth of 18 feet from thence to Chestnut Street Bridge in Philadelphia, about 3 miles.

In 1875 and 1883 this project was amended so as to increase the low-water channel between the mouth and Girard Point, a distance of about 1 mile, to 400 feet wide and 24 feet deep, and from Girard Point to Gibson's Point, about 3 miles, to 250 feet wide and 20 feet deep.

The amount expended upon these projects to June 30, 1888, was \$368,519.13, and had resulted in the formation of a channel as follows: Between the mouth and Girard Point piers, the minimum channel was 150 feet wide and from 18 to 19 feet deep at mean low water; from Girard Point to Gibson's Point the channel was 50 to 150 feet wide and 20 feet deep; from Gibson's Point to Chestnut Street Bridge the channel was of navigable width and 18 feet deep at mean low water. This latter reach of river has required no other improvement than the removal of about 1,000 cubic yards of rock near Locust and South streets.

During the fiscal year ending June 30, 1889, the sum of \$24,862.50 was expended in widening by dredging the previously existing 20-foot channel between Point Breeze and Penrose Ferry Bridge. The work accomplished has resulted in the formation of a channel 250 feet wide and 20 feet deep at mean low water from the wharves at Point Breeze to a point $1\frac{1}{2}$ miles below, and from thence to Penrose Ferry Bridge, about three-fifths of a mile, a channel of the same depth and not less than 100 feet wide.

In the opinion of the officer in charge the shoal areas between the mouth and Girard Point can be more economically improved by the construction of a dike than by the hitherto proposed dredging.

July 1, 1888, amount available.....	\$230.87
Amount appropriated by act of August 11, 1888	25,000.00
	<hr/> 25,230.87
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	24,862.50
July 1, 1889, balance available	<hr/> 368.37

{ Amount (estimated) required for completion of existing project.....	\$91,250.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	50,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix G 3.)

4. *Ice harbor at Marcus Hook, Pennsylvania.*—This work in its present plan was commenced in 1866, the object being to provide a harbor in the Delaware River to protect vessels against moving ice.

In 1785 the Commonwealth of Pennsylvania built, for the convenience of commerce, piers at Marcus Hook extending from the shore-line into the river. It is assumed that at some subsequent time these shore-piers were turned over to the United States, since in 1829 an appropriation was made of \$5,000, for repairing these piers, improving the harbor, and removing obstructions. No further appropriation was made until 1866.

At this latter date the project was adopted for the construction of detached piers in the harbor, consisting of stone superstructures upon crib foundations filled with stone, together with the deepening of the harbor by dredging.

In 1881 it was proposed to increase the area of the harbor by the construction of a bulkhead about 1,800 feet in length parallel to the shore-line and about 150 feet outside of high-water line, and the deepening of this added area by dredging.

Nothing was done towards the carrying into effect of the modification of 1881, on account of the unwillingness of some of the abutting property owners, and in 1888 this hitherto proposed modification was abandoned and an increased depth proposed for the areas protected by the detached piers outside of the natural shore-line of the river.

The amount expended from 1866 to June 30, 1888, was \$193,919.29, and resulted in the construction of two shore or landing piers, and seven detached ice-piers, the deepening by dredging of the area protected by the piers, and the placing of mooring piles within the harbor. By this expenditure a harbor was formed with an area of about $7\frac{1}{2}$ acres, carrying a depth of from 12 to 25 feet at mean low water.

During the fiscal year ending June 30, 1889, \$14,426.60 was expended in extensive repairs to the United States shore piers and mooring piles, and in deepening by dredging the area which is protected by the shore and detached piers. In its present condition the harbor has an area of about 10 acres, with a depth of from 12 to 25 feet at mean low water.

July 1, 1888, amount available.....	\$90.71
Amount appropriated by act of August 11, 1888.....	15,000.00
	<hr/>
	15,090.71
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	14,426.60
	<hr/>
July 1, 1889, balance available.....	664.11
	<hr/>

{ Amount that can be profitably expended in fiscal year ending June 30, 1891	5,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix G 4.)

5. *Ice-harbor at head of Delaware Bay, Delaware.*—The act of August 2, 1882, appropriated \$25,000 for the commencement of work on the ice-harbor at the head of Delaware Bay, to include the removal of some

sunken piers, the remains of an old ice-harbor, in the channel east of Reedy Island, Delaware.

The necessity for an ice-harbor at the head of Delaware Bay has long been recognized, and considerable study has been devoted to the questions of location and general plan of construction. As to location, the prevailing judgment would place the ice-harbor at or very near Listin's Point. The plan of construction which has been hitherto proposed in general terms provided for a nearly inclosed area by means of a barrier to protect vessels against moving ice. This barrier was to consist of iron piles placed at intervals and connected with an iron superstructure so arranged as to either hold or ward the ice from the area within the barrier. The cost of such an ice-harbor has been variously estimated at from \$300,000 to \$400,000.

In the opinion of the officer in charge, the plan of detached ice-breakers, as heretofore used in all the ice-harbors on the Delaware River, is preferable to that of an inclosed area, which latter would prevent the broken ice from escaping from the harbor.

The amount expended to June 30, 1888, was \$8,723.07, of which \$3,700 was applied to the removal of the sunken piers back of Reedy Island, as provided in the act of August 2, 1882, making the appropriation of \$25,000. The balance was expended in surveys, examinations, and preliminary studies.

During the fiscal year ending June 30, 1889, nothing was expended :

July 1, 1888, amount available.....	\$16,276.93
July 1, 1889, balance available.....	16,276.93

(See Appendix G 5.)

6. Construction of iron pier in Delaware Bay, near Lewes, Delaware.—

The original project for this work proposed the construction of a landing pier about 1,700 feet in length, extending from the shore south of the breakwater into Delaware Bay to a depth of 22 feet at mean low water, the pier to consist of a substructure of wrought-iron screw-piles surmounted with a timber superstructure. The work was commenced in 1871 and completed, except as to superstructure, in 1880.

The amount expended to June 30, 1888, was \$368,375.06, and resulted in the construction of 1,155 linear feet of pier 21 feet in width, and 546 linear feet 42 feet in width, or a total length of 1,701 feet. The depth of water at the outer end of the pier-head was about 21 feet at mean low water.

During the fiscal year ending June 30, 1889, nothing was expended.

During the gale of March 12, 1888, five of the wrought-iron screw-piles were injured by the collision of a wrecked schooner. The injury to the pier was limited to its half width for a distance of about 125 feet. The officer in charge estimates that the cost of repairing this injury will probably reach \$6,000.

From the decayed condition of the timber superstructure it is not available for use by the railroad to which the right was given to use the pier under the provisions of the act of July 15, 1870.

If the pier is to be rendered available for the general purposes of the Government, and also for railroad traffic, as contemplated in the act above referred to, the officer in charge recommends the replacing of the present decayed wooden superstructure by permanent iron-work, at an estimated cost of \$93,000.

July 1, 1888, amount available.....	\$124.94
July 1, 1889, balance available.....	124.94

{ Amount (estimated) required for completion of existing project	\$15,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	6,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix G 6.)	

7. *Delaware Breakwater Harbor, Delaware.*—Under act of Congress, May 7, 1822, \$22,700 was appropriated for a survey of Delaware Bay, near Cape Henlopen, for the purpose of determining upon the site for a harbor of shelter. In 1828 an appropriation of \$250,000 was made for commencing the work under a plan submitted by a Board of Commissioners appointed by Congress.

The project of the Board contemplated the construction in the concavity of the bay, just inside Cape Henlopen, of two massive works on the piers perdues or riprap system, separated by an interval or gap of 1,390 feet—the greater, called the breakwater, to afford safe anchorage during gales from the north and east; the other, called the ice-breaker, to protect shipping against northwesterly gales and the heavy drifting ice of the bay.

This project was completed in 1869, under aggregate appropriations, including the first for survey, of \$2,192,103.70. The stone used in the work amounted to 892,528 gross tons, and varied from one-quarter of a ton to 7 tons in weight, the smaller constituting the bulk of the mass, the larger used to cover the exterior slopes.

As completed in 1869 the breakwater is 2,558 feet long, and the ice-breaker 1,359 feet long on top. The average width on top is 22 feet, and at base 160 feet. The top is from 12 to 14 feet above mean low water.

In 1882 a project was adopted for closing the gap between the breakwater and the ice-breaker by means of a random stone foundation with a concrete superstructure. The random stone foundation is to be brought to a height of 12 feet below low water, with a width on top of 48 feet. The concrete superstructure is to have a width on bottom of 24 feet, rising to a height of 12 feet above mean low water, with a width on top of 12 feet. The estimated cost of this project was \$675,000.

In 1883 and 1884 the project was modified by providing a foundation of brush mattresses for the random stone superstructure, and omitting the construction of a pile bridge across the gap, which formed part of the project of 1882 for closing the gap.

From the beginning of the work in 1822 to June 30, 1888, the total amount expended was \$2,447,823.61, of which \$255,719.91 was expended on the project of 1882 for closing the gap.

During the fiscal year ending June 30, 1889, \$50,576.74 was expended in the formation of the random stone substructure for the work, which is intended to close the gap between the breakwater and ice-breaker. The total expenditure to June 30, 1889, has been \$2,498,400.35, of which \$306,296.65 has been under present project.

July 1, 1888, amount available	\$530.09
Amount appropriated by act of August 11, 1888	100,000.00
	<hr/> 100,530.09
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$50,576.74
July 1, 1889, outstanding liabilities	5,172.48
July 1, 1889, amount covered by existing contracts	39,705.15
	<hr/> 95,454.37
July 1, 1889, balance available	<hr/> 5,075.72

{ Amount (estimated) required for completion of existing project.....	\$318,750.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	200,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix G 7.)

8. *Mantua Creek, New Jersey.*—The original project for this improvement contemplates the construction of a low-water channel 10 feet deep and 80 feet wide at the mouth of the creek, which is to diminish to 4 feet in depth and 40 feet in width at the town of Mantua, situated some 11 miles from the mouth, at an estimated cost of \$35,000.

The stream in its natural condition, as shown by the survey of 1881, had at its mouth (one-fourth mile outside the high-water line) 8 feet at mean low water and nearly that depth at a second bar one-half mile up the stream. If these two bars had been improved, there would have been a 9-foot channel up to a bar $1\frac{1}{2}$ miles from the mouth, where there was a maximum depth of 7 feet. The lower $1\frac{1}{2}$ miles of the stream can not safely be said to have had in its natural condition in 1881 a navigable channel with a greater depth than $7\frac{1}{2}$ feet, while there was a navigable channel with $6\frac{1}{2}$ feet for $4\frac{1}{2}$ miles farther, and thence to Mantua, 11 miles from the mouth, a channel gradually diminishing to 2 feet.

At the request of parties interested in the lower part of the river the lower one-half mile has been resurveyed, showing a shoaling of from 1 to 2 feet during the last eight years. At one point in the channel of navigable width there is only 5 feet of water. The officer in charge has recommended the expenditure of the \$3,000 appropriated August 2, 1882, in dredging a channel with a least width of 60 feet and a least depth of 8 feet at mean low water from the mouth up to the Phosphate Works, a distance of about one-half mile. Up to the present time nothing has been expended in improving this stream.

July 1, 1888, amount available	\$3,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	84.34

July 1, 1889, balance available.....	2,915.66
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(See Appendix G 8.)

9. *Removal of wrecks from Delaware Bay and River.*—During the past fiscal year no wrecks have been removed under this appropriation.

July 1, 1888, amount available	\$758.62
July 1, 1889, balance available	758.62

(See Appendix G 9.)

10. *Removing sunken vessels or craft obstructing or endangering navigation.*—During the past fiscal year the following wrecks were removed under the provisions of the act of June 14, 1880: The schooner *Sallie C. Morton* from the Cape May channel into Delaware Bay, and the schooner *Lizzie* from the mouth of English Creek, New Jersey.

(See Appendix G 10.)

11. *United States Commission Advisory to the Board of Harbor Commissioners of Philadelphia, Pennsylvania.*—This Commission, which was created May 25, 1880, was dissolved by order of the President of the United States under date of February 25, 1889.

(See Appendix G 11.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH
REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11,
1888.

The required preliminary examination of *Little Salem Creek, New Jersey*, was made by the local engineer in charge, Lieutenant-Colonel Robert, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers concurring in the conclusion reached in this instance, has given no instructions to make further survey with the view to its improvement.

(See Appendix G 12.)

It appearing from the report of the preliminary examination made by the local engineer that *Alloway Creek, New Jersey*, is worthy of improvement, and the public necessity therefor being apparent from the facts and reasons reported, which are concurred in by the Chief of Engineers, Lieutenant-Colonel Robert was charged with its survey, the results of which will be submitted when received.

IMPROVEMENT OF HARBORS AND RIVERS IN THE STATES OF DELA-
WARE AND MARYLAND, AND OF MAURICE RIVER, NEW JERSEY,
AND OF THE INLAND WATER WAY FROM CHINCOTEAGUE BAY, VIR-
GINIA, TO DELAWARE BAY.

Engineer in charge, William F. Smith, United States Agent, Major of Engineers, U. S. Army, retired; division engineer, Col. W. P. Craig-hill, Corps of Engineers, since December 3, 1888.

1. *Maurice River, New Jersey*.—This stream has a natural channel from 10 to 40 feet deep from the mouth to Ferguson's Dock, 4 miles below Millville, a distance of about 20 miles. Near this dock the 6-foot curve disappeared before improvements were commenced, and the river above was quite shoal, with a minimum depth of 2 feet.

The adopted project is to make a 6-foot low-water channel to Millville, and a 4-foot channel in front of the wharves to the head of navigation. Twenty-four thousand nine hundred and eighty-five dollars and sixteen cents have been expended up to the close of the fiscal year ending June 30, 1888, in dredging this channel, which has attained its full proposed width and depth to a point 1 mile below Millville. The upper portion remains to be dredged to the full dimensions as projected.

It is said that the commerce of the river has more than doubled, since a larger class of vessels has been able to reach without interruption by low tides the wharves at Millville, which is a manufacturing center of considerable importance.

The appropriation of \$10,000, made by the act of August 11, 1888, had not been expended at the close of the fiscal year on account of the prevailing high prices for dredging.

The available funds will during the next fiscal year be applied to the improvement of the channel at and near Millville, and the amount asked for, if appropriated, will be expended at the same locality.

July 1, 1888, amount available.....	\$14. 84
Amount appropriated by act of August 11, 1888	10, 000. 00
	<hr/>
	10, 014. 84
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	23. 77
	<hr/>
July 1, 1889, balance available	9, 991. 07
	<hr/>

{ Amount (estimated) required for completion of existing project	\$77,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	20,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 1.)

2. *Wilmington Harbor, Delaware.*—In 1836, when the first appropriation for the improvement of the Christiana River was made, the depth of water at low tide was between 8 and 9 feet at the entrance and about 8 feet at the shoalest place below Third Street Bridge. The channel depth was that year increased to 10 feet by dredging.

In 1871 a more comprehensive project was made to dredge a channel 12 feet in depth from the mouth to above the city of Wilmington. This project was completed in 1881. A new project was submitted in 1881 and approved by a Board of Engineers for a 15-foot channel as far as the Pulp Works and a 12-foot channel to the Delaware Railroad Bridge, and the construction of a jetty at the mouth to control and direct the ebb tide, at a total estimated cost of \$175,551. The details of this project were somewhat changed in 1883 and the cost in a revised estimate increased to \$191,384, exclusive of the jetty, which was then nearly finished.

The following year the project was amended to provide for an additional height of 4 feet to the jetty and to extend it 322 feet in length. The total amount appropriated for the improvement of this harbor since 1836 is \$289,606.

The total amount expended up to the close of the fiscal year ending June 30, 1888, is \$255,028.57.

The result is a channel 15 feet deep at mean low water and from 50 to 75 feet wide between Market Street Bridge and the entrance, with the exception of Four Shoals, where the depth is from 10 to 15 feet, the shoaling having been mainly caused by material running in from the sides of the cut. The channel dredged to the Pulp Works in 1881 to a depth of 12 feet has shoaled to 10 feet. During the fiscal year repairs to the extent of \$500 have become necessary on the jetty and will soon be completed. The available funds are to be expended in dredging a channel 15 feet deep at low water, and 150 feet wide from the mouth of the river as far as the funds will permit. Advertisements inviting proposals have been published and it is expected to complete the work of dredging before next winter.

July 1, 1888, amount available	\$2,166.21
Amount appropriated by act of August 11, 1888	30,000.00
	<hr/> 32,166.21
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	2,201.44
July 1, 1889, balance available	<hr/> 29,964.77

{ Amount (estimated) required for completion of existing project	117,624.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	50,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 2.)

3. *Ice-harbor at New Castle, Delaware.*—The ice-harbor at New Castle is one of the oldest in the Delaware River, having been constructed in colonial times for the protection of shipping against heavy ice. Since the beginning of the present century its extension and improvement have been carried on by the General Government at intervals, and the

harbor is crowded with vessels of all kinds and dimensions every winter.

The existing project is to rebuild one of the eight piers in the harbor. To do this about \$15,600 is required. The amount appropriated by the act of August 11, 1888, viz, \$7,500, is too small to be now expended with economy and advantage, and the expenditure thereof has therefore been postponed until a further appropriation is made.

It is proposed to expend the amount asked for, if appropriated, together with the available balance, in rebuilding pier H, and in dredging, as far as the funds will permit, the bottom above and below the harbor, to a greater depth.

Amount appropriated by act of August 11, 1888	\$7,500. 00
July 1, 1889, balance available	7,500. 00

{	Amount (estimated) required for completion of existing project	8,100. 00
	Amount that can be profitably expended in fiscal year ending June 30, 1891	8,100. 00
	Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 3.)

4. *Duck Creek, Delaware.*—In the year 1879, before improvements were commenced, there was a minimum depth of 2½ feet in Duck Creek, and over the bar at the entrance a depth of 4 feet. Navigation was possible only at high water and was carried on by one small steamer and about seven small sailing vessels.

A project was submitted in 1878, by Col. J. N. Macomb, Corps of Engineers, for the improvement of the creek, including a plan for deepening the channel at the entrance. This portion of the project was considered paramount to the other by Congress, and a total sum of \$10,000 was appropriated during the following four years for dredging a channel across the bar 100 feet wide and 8 feet deep at mean low water.

During the fiscal year the appropriation of \$10,000 made by the act of August 11, 1888, was expended. A channel 40 feet wide and 6½ feet deep at low water was dredged from Smyrna Landing to Brick Store Wharf, a distance of 3 miles.

The result has been that all vessels can now navigate the creek 2 miles above the former highest landing, and that the principal shipping point has been brought this distance nearer the center of the rich farming country which surrounds the head waters of Duck Creek.

It is proposed, during the next fiscal year, to expend the amount asked for, if appropriated, in dredging within the creek and to complete the channel therein in accordance with the present project.

Amount appropriated by act of August 11, 1888	\$10,000. 00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	9,910. 28

July 1, 1889, balance available	89. 72
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{	Amount (estimated) required for completion of existing project	27,365. 00
	Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000. 00
	Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 4.)

5. *St. Jones River, Delaware.*—Before the channel was improved the practicable depth of water to Lebanon, 12 miles above the mouth, was 4 feet; to Dover, 9 miles further up, only 2½ feet at mean low water.

The original project was for a 4-foot low-water channel, 100 feet wide across the bar at the mouth, protected by a jetty, at an estimated cost

of \$35,000. This project was enlarged in 1884 to include the removal of the shoals in the river to a depth of 6 feet at mean low water.

The total amount expended up to the close of the fiscal year ending June 30, 1888, is \$24,999.64.

The original project for the improvement of the entrance was modified in March last, and a new cut-off proposed near Wharton's Fishery near Lebanon. This modification will reduce the original estimate considerably, and the cut-off will shorten the distance between the upper and lower river 1 mile.

The improvements within the river, with the exception of the cut-off above mentioned, are completed, and there is now a clear channel 40 feet wide and 6 feet deep from the mouth to Dover.

Proposals for dredging were opened June 21, 1889, and contract will be entered into early in the next fiscal year.

The amount now available is sufficient to complete the improvement, and no further appropriation is recommended.

July 1, 1888, amount available.....	\$0.36
Amount appropriated by act of August 11, 1888.....	15,000.00
	<hr/> 15,000.36
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$412.20
July 1, 1889, amount covered by existing contracts.....	11,900.00
	<hr/> 12,312.20
July 1, 1889, balance available	2,688.16
(See Appendix H 5.)	

6. Mispillion Creek, Delaware.—The entrance to this creek from the Delaware Bay has a mean low-water depth of only $1\frac{1}{2}$ feet. Within the creek the original least depth of water at several shoals was from 4 to 5 feet.

The original project is based upon an examination made in 1879, and is for a 6-foot channel, 40 feet wide, from Milford, the head of navigation, to the mouth.

A project was submitted in 1881 for either a 4-foot or a 3 foot channel, 150 feet wide, and protected by a jetty across the bar at the mouth.

The total amount that has been appropriated for this creek is \$17,000, which was nearly all expended within the stream. The result is a 6-foot low-water channel from Milford to Flat Reach Shoal, near the mouth, a distance of 12 miles.

The sum of \$3,500 has been expended during the fiscal year in dredging the project as above; \$2,000 is required to complete the present project.

Amount appropriated by act of August 11, 1888.....	\$3,500.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	3,500.00
	<hr/> 2,000.00
{ Amount (estimated) required for completion of existing project.....	2,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 6.)

7. Broadkill River, Delaware.—In its original condition the depth of water in the river was only from 3 to 4 feet over the numerous shoals which impeded navigation, then carried on by small vessels. The depth at the entrance is from $1\frac{1}{2}$ to 2 feet.

A project for a 6-foot low-water navigation from the mouth to the head of navigation at Milton, and for a new entrance across Lewes

Cape was adopted in 1871, and since that time the execution of the part of the project relating to the river proper has been in progress and is nearly completed. Twenty-five thousand dollars has been expended to the close of the fiscal year ending June 30, 1888. The result has been a considerable increase in shipping and commerce and the inauguration of steamboat navigation.

No improvements were made in the river during the fiscal year ending June 30, 1889, as the prevailing prices for dredging were so high, and the condition of the channel is such that there was no urgent necessity for the expenditure of the appropriation of \$10,000 of August 11, 1888.

The available funds will be expended as soon as there are more favorable prospects for lower prices for dredging during the next fiscal year. This will complete the improvement within the river.

The sum of \$21,500, it is estimated, will be required for the completion of the existing project at the entrance, but it is thought advisable to postpone further action for the present, on account of the possibility of the opening of a new and elaborate outlet not far from the mouth of Broadkirk River, for the inland waterway canal between Chincoteague Bay, Virginia, and Delaware Bay, at or near Lewes, Delaware, which is now in progress of construction.

Amount appropriated by act of August 11, 1888.....	\$10,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	408.79

July 1, 1889, balance available.....	9,591.21
--------------------------------------	----------

{ Amount (estimated) required for completion of existing project.....	21,500.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 7.)

8. *Inland water-way from Chincoteague Bay, Virginia, to Delaware Bay, at or near Lewes, Delaware.*—This improvement is made with the view of forming an inland water-way between Chincoteague Bay, Virginia, and Delaware Bay, Delaware.

The project contemplates a "dead level" tidal canal 6 feet deep below the mean low-water level in the Delaware Breakwater Harbor and 70 feet wide at the bottom, beginning at the head of Chincoteague Bay, following deep water in Sinepuxent, Isle of Wight, and Assawoman bays, dredged across the high land near Ocean View, Delaware, to Indian River Bay, from thence across that and Rehoboth Bay and the high land intervening between the head of Rehoboth Bay and the Delaware Bay shore, at or near Lewes, Del., into the harbor of the Delaware Breakwater. The estimated cost is \$350,000.

Two appropriations have been made for this work: One of \$18,750 by act of August 5, 1886, and one of \$50,000 by act of August 11, 1888. By direction of Congress both were to be expended upon that section of the line between Chincoteague Bay and Indian River Bay.

A project for the expenditure of this money in excavating a cut 4 miles long and smaller in dimensions than the final profile has been approved.

After the question of payment for land damages by the State of Delaware had been settled and finally approved by the Attorney-General of the United States, the work was advertised in October last and proposals were opened on November 2, following, and the bids being considered too high were rejected.

Proposals were again opened December 18, 1889, after readvertisement. The lowest bidder was found to be irresponsible, and contract was entered into with Mr. C. McLean, of New York, the next lowest bidder, at 21.9 cents per cubic yard, place measurement.

Work was commenced February 14, 1889, and has been greatly delayed by unfavorable weather. At the close of the fiscal year 46,619 cubic yards of material had been excavated, less than one-third of the whole amount to be removed. The contractor had agreed to complete the work by August 1, 1889.

The depths of cutting made are yet shallow and irregular, being surface excavations merely, that extend over the whole line but in no case reach the specified level.

The sum of \$841.21 was expended up to the close of the fiscal year ending June 30, 1888.

During the current fiscal year the sum of \$13,834.19, including outstanding liabilities, has been expended.

It is expected that by this improvement about 150 miles of navigable rivers and bays will be rendered available, giving a new outlet to 400 square miles of territory. The amount of commerce interested is estimated at nearly \$2,000,000.

Of the total length of the canal, which is about 73 miles, about 15 miles will have to be improved. To effect a rapid and economical completion large sums of money are required. An appropriation of \$50,000 is recommended for the fiscal year ending June 30, 1891.

July 1, 1888, amount available.....	\$17,928.59
Amount appropriated by act of August 11, 1888	50,000.00

67,928.59

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$11,565.40
July 1, 1889, outstanding liabilities	2,268.79
July 1, 1889, amount covered by existing contract.....	31,823.78
	<hr/> 45,657.97

July 1, 1889, balance available.....	22,270.62
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Amount (estimated) required for completion of existing project.....	281,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1891	50,000 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 8.)

9. *Broad Creek, Delaware.*—The original depth in Broad Creek directly below the Delaware Railroad bridge was on an average $1\frac{1}{2}$ feet; above the bridge it averaged 2 feet. There were minimum depths of only 6 inches at low water. The rise and fall of the tide was in consequence also very small.

The original project was made for a 7-foot low-water channel 60 feet wide to the head of navigation, at an estimated cost of \$46,500; if wing-dams or training-walls were added, the cost would be \$60,000.

The project was amended in 1883 by reducing the proposed channel depth to 6 feet and the width to 50 feet; the amount required to complete this project was then estimated at \$32,625, which included 10,000 linear feet of diking. At the close of the fiscal year ending June 30, 1888, \$30,000 had been expended and the channel as projected was nearly completed.

The act of August 11, 1888, appropriated \$5,000 for continuing improvement. A contract has been made to expend this amount in dredging between the Delaware Railroad bridge and the turning basin at

Laurel, the head of navigation. Operations had not been commenced at the close of the fiscal year, but it is expected that the contractor will complete the work by December 31, 1889.

It is stated that the commerce of Broad Creek has increased from 25 to 30 per cent. since it has been improved. The Delaware Railroad Company has recently replaced the former permanent bridge below Laurel by a draw-bridge, and vessels are now enabled to reach the wharves at that town without lighterage.

The expenditure of the available funds will complete the dredging of the channel as originally proposed, and no further appropriation is recommended.

Amount appropriated by act of August 11, 1888.....	\$5,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$21.75
July 1, 1889, amount covered by existing contracts.....	4,250.00
	<u>4,271.75</u>
July 1, 1889, balance available	<u>728.25</u>

{ Amount (estimated) required for completion of existing project.....	27,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 9.)

10. *Susquehanna River, above and below Havre de Grace, Maryland.*—Before improvements were commenced in this section of the river the least depth of water over two shoals which were then in existence between the light-house at Havre de Grace and Specutia Island below was from 5 to 6 feet at mean low-water. The channel between Watson's Island and a large shoal on the west shore was very narrow and occasioned many serious ice-gorges at and near Port Deposit.

The improvements have been in progress since 1852. The present general project is for a 15-foot low-water channel below Havre de Grace and to remove a shoal on the west side of the channel near Watson's Island to a depth of 8 feet. The channel below Havre de Grace was dredged in 1885 to a depth of 12 feet and a width of 100 feet, and its present condition is unknown. The channel west of Watson's Island has been increased from 300 to 400 feet in width.

Up to the close of the fiscal year ending June 30, 1888, \$148,890 had been expended.

A contract has been made for the expenditure of the appropriation of August 11, 1888, of \$10,000, in widening the channel near Watson's Island, for the relief of ice-gorges. The work was not yet begun at the close of the fiscal year but will be completed before next winter.

Ten thousand dollars can be profitably expended during the fiscal year ending June 30, 1891, in deepening the channel below Havre de Grace to 15 feet.

Amount appropriated by act of August 11, 1888.....	\$10,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$21.35
July 1, 1889, amount covered by existing contracts	8,500.00
	<u>8,521.35</u>
July 1, 1889, balance available	<u>1,478.65</u>

{ Amount that can be profitably expended in dredging during the fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 10.)

11. *Fairlee Creek, Maryland.*—The project for the improvement of this stream is for a 7-foot low-water channel 100 feet wide across the bar at the mouth and inside the creek to the head of navigation, a distance of nearly 3 miles, at an estimated cost of \$15,558. This project is based upon a survey made in 1887, in compliance with the requirements of the river and harbor act of August 5, 1886.

The original depth at the mouth before the improvement was commenced was 2 feet, inside the creek 5 feet, at mean low water, and navigation was carried on by a few flat-bottomed lime-boats.

The first appropriation, \$5,000, was made by the act of August 11, 1888. The amount expended during the fiscal year ending June 30, 1889, including outstanding liabilities, is \$4,690.69.

A cut across the bar, about 900 feet long, 80 feet wide, and 7 feet deep at mean low water, was made. What the benefits will be upon the future commerce of the creek is a matter of conjecture, as it is very limited at present.

The balance required to complete the present project can be profitably expended if appropriated during the fiscal year ending June 30, 1891, and will be applied to widening the channel across the bar and in dredging the creek in accordance with the approved project.

Amount appropriated by act of August 11, 1888.....	\$5,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$2,587.65
July 1, 1889, outstanding liabilities.....	2,103.03
	<hr/>
	4,690.69
July 1, 1889, balance available.....	<hr/>
	309.31

{ Amount (estimated) required for completion of existing project.....	10,558.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	11,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 11.)

12. *Corsica Creek, Maryland.*—Before improvements were made there was an ample depth of water in this stream as far as Hooper's Landing, about $4\frac{1}{2}$ miles above the mouth. From there to the head of navigation at Centreville the depth was less than 8 feet and the channel very narrow.

The original project, adopted in 1882, provides for a channel 100 feet wide and 8 feet deep at mean low water from the above landing to the bridge at Centreville, including a turning basin at the latter place, at an estimated cost of \$30,000.

Twenty thousand dollars had been expended at the close of the fiscal year ending June 30, 1888. During the current fiscal year the sum of \$9,405.59, including outstanding liabilities, was expended in widening the channel to 100 feet, and increasing the depth to 8 feet, where necessary.

The result is the completion of the channel in accordance with the original project, and no further appropriations are recommended.

Steamers which formerly could not go beyond Hooper's Landing now land directly at Centreville, where large improvements have been made along the river-front by private individuals. The expense of lighterage of grain and other products, which was a heavy tax on the community before the improvement was begun in 1882, is now done away with, and the added shipping facilities have been of great benefit to Centreville and surrounding country.

Amount appropriated by act of August 11, 1888.....	\$10,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$4,875.60
July 1, 1889, outstanding liabilities.....	4,529.99
	<hr/>
	9,405.59
July 1, 1889, balance available.....	594.41

(See Appendix H 12.)

Choptank River, Maryland.—At the time the project for the improvement of this river was made, the depth of water between Denton and Greensborough varied from 2 to 8 feet at low water. Navigation by small sailing vessels extended to a landing 3 miles above Denton, called "The Stakes." Lighters were necessary for the transportation of freight beyond that point to Greensborough, a further distance of 5 miles.

A project was made in 1880 for an 8-foot low-water channel, 75 feet wide, at an estimated cost of \$79,000. During the three following years the channel was only made 6 and 7 feet deep on account of the smallness of the appropriations and high prices for dredging. Since 1885 the originally proposed depth has been made whenever possible; \$30,000 had been expended up to the close of the fiscal year ending June 30, 1888.

The result is a channel from 5 to 8 feet deep at low water, and from 25 to 75 feet wide between Denton and Greensborough. A 300-ton steam-barge now runs between the latter town and Baltimore, and a small steamer between Denton and Greensborough, connecting at the former place with the larger steamers from Baltimore.

Nothing was done during the fiscal year beyond advertising twice for proposals for dredging. The lowest bid in each case was considered too high and rejected, and the expenditure of the appropriation was postponed until a larger amount becomes available, when it is thought better prices can be obtained.

It is proposed to expend the available funds in widening the channel near Greensborough to 40 feet and increasing the depth to 8 feet, and the amount asked for, if appropriated, will be applied to widening the channel throughout to 75 feet, in accordance with the original project, which, it is believed, will be sufficient to meet all the requirements of the present and future commerce of the river.

Amount appropriated by act of August 11, 1888.....	\$7,500.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	76.26
	<hr/>
July 1, 1889, balance available.....	7,423.74

{ Amount (estimated) required for completion of existing project.....	30,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891.	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 13.)

14. *Cambridge Harbor, Maryland.*—The entrance to this harbor originally had a depth of only 4½ feet at the shoalest place. The average depth in the harbor was about 3 feet; a few deep holes had a depth of 8 and 9 feet. Strong northwesterly winds often made the bar impassable for vessels drawing 3 feet. The local commerce was in consequence limited to a few vessels of the smallest class and one steamer of light draught. Improvement was commenced in 1871 and completed in 1879, resulting in a channel across the bar 100 feet wide and an increase of anchorage ground in the inner harbor, both having been dredged to a depth of 8 feet at mean low water in accordance with the

original project. During the year 1884 the channel at the entrance was slightly widened; \$32,500 had been expended up to the close of the fiscal year ending June 30, 1888.

A new project was submitted in 1887, based upon a survey made under the requirements of the river and harbor act of August 5, 1886, for a channel 12 feet deep at mean low water and 150 feet wide from the Choptank River to the railroad wharf, and for dredging the inner harbor below the draw-bridge to 10 feet and above the bridge to 8 feet at mean low water, at an estimated cost of \$17,736.60; \$5,000 was appropriated by the act of August 11, 1888.

The sum of \$4,828.91 was expended during the fiscal year ending June 30, 1889, and the result is an available channel 12 feet deep at mean low water and 88 feet wide across the bar at the entrance from the Choptank River to a point opposite the Maryland Steamboat Company's wharf and 22 feet wide thence to the railroad wharf. This has already proved a great benefit to the commerce of the harbor. For the first time vessels drawing 11½ feet of water have been able to land at the railroad wharf.

The sum of \$13,000 can be profitably expended during the fiscal year ending June 30, 1891, and this amount, if appropriated, will be applied to continuing the improvement in accordance with the adopted project.

Amount appropriated by act of August 11, 1888.....	\$5,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	4,828.91
July 1, 1889, balance available.....	171.09

Amount (estimated) required for completion of existing project.....	12,736.60
Amount that can be profitably expended in fiscal year ending June 30, 1891	13,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 14.)

15. *Pocomoke River, Maryland.*—The project for this improvement was to make a cut-off 1,100 feet in length, with a channel 80 feet wide and 7 feet deep, through a low neck of land forming four abrupt bends below Snow Hill, Md., which rendered navigation difficult and dangerous, especially in high winds.

The project was completed in June of the fiscal year ending June 30, 1888. Up to the close of that year the amount expended on the project was \$6,777.51, including outstanding liabilities.

No further funds are needed for this improvement at present. At the close of the last fiscal year there was a good 7-foot low-water channel to the head of navigation at Snow Hill, Md.

July 1, 1888, amount available	\$1,222.49
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	1,222.49

(See Appendix H 15.)

16. *Removing sunken vessels or craft obstructing or endangering navigation.*—The wrecks of the puny *Eva Hemingway*, sunk in the Choptank River, near the entrance to Cambridge Harbor, Maryland, and the schooner *Two Brothers*, sunk in Cambridge Harbor, were reported April 26, 1889, as obstructions to navigation.

The usual notice of 30 days to parties interested was published on May 17, 1889, and proposals for their removal were invited, the bids to be opened on July 18, 1889.

(See Appendix H 16.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH
REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11,
1888.

The required preliminary examinations of the following localities were made by the local engineer in charge, William F. Smith, United States agent, major of Engineers, U. S. Army, retired, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers, concurring in the conclusions reached in these instances, has given no instructions to make further survey with the view to their improvement.

1. *Prime Hook Creek, Delaware.*—(See Appendix H 17.)

2. *Still Pond Harbor, Maryland.*—(See Appendix H 18.)

Preliminary examinations of the following localities were made by the local engineer, William F. Smith, United States agent, major of Engineers, U. S. Army, retired, and reported by him as worthy of improvement:

1. *Mahon River, Delaware.*—(See Appendix H 19.)

2. *Wetipkin River, Maryland.*—(See Appendix H 20.)

3. *South East River, Maryland.*—(See Appendix H 21.)

4. *Ocohanock River, Virginia.*—(See Appendix H 22.)

5. *Nassawadox River, Virginia.*—(See Appendix H 23.)

6. *Nanticoke River, from Seaford to Concord, Delaware.*—(See Appendix H 24.)

7. *Warwick River, Maryland.*—(See Appendix H 25.)

8. *La Trappe River, Maryland.*—(See Appendix H 26.)

9. *Tuckahoe River, Maryland.*—(See Appendix H 27.)

10. *Sassafras River, Maryland.*—(See Appendix H 28.)

The division engineer, Col. William P. Craighill, did not concur in the opinion of Major Smith. I am not satisfied that these localities are worthy of improvement, and for this reason surveys have not been ordered.

It appearing from the report of the preliminary examination made by the local engineer that the following localities are worthy of improvement, and the public necessity therefor being apparent from the facts and reasons reported, which are concurred in by the Chief of Engineers, W. F. Smith, United States agent, major of Engineers, U. S. Army, retired, was charged with their survey, the results of which will be submitted when received:

1. *Appoquinimink Creek, Delaware.*

2. *Wicomico River, Maryland.*

3. *Chester River, between Crumpton and Jones' Landing, Maryland.*

4. *Onancock Harbor, Virginia.*

5. *Chincoteague Inlet, Virginia, for purposes of a breakwater.*

6. *North East River, Maryland.*

7. *Elk River, Maryland.*

8. *Harbor of Cape Charles City and approaches by Cheuton Inlet, Virginia.*

9. *Manokin River, Maryland.*

IMPROVEMENT OF PATAPSCO RIVER AND CHANNEL TO BALTIMORE,
MD., AND OF JAMES RIVER, VIRGINIA.

Officer in charge, Col. William P. Craighill, Corps of Engineers, until March 30, 1889, and after that date Capt. Thomas Turtle, Corps of Engineers. Lieut. G. J. Fiebeger, Corps of Engineers, was under the

immediate orders of the officer in charge from August 30 to November 22, 1888, and Lieut. W. E. Craighill, Corps of Engineers, temporarily under the immediate orders of the officer in charge from January 12 to March 29, 1889.

1. *Channel to Baltimore, Maryland.*—The depth of this channel has been by successive steps increased from 17 feet at mean low water to 27 feet, with an average rise of tide of about 18 inches.

The project of improvement first adopted and commenced in October, 1853, had for its object to give a channel 22 feet at mean low water with a width of 150 feet.

Little was done before the late war, but afterwards these dimensions were increased, a depth of 24 feet at mean low water being determined upon with a width of channel ranging from 250 to 400 feet.

This channel was completed in 1874, important changes of position having been given to a portion of it, by which the distance was materially lessened and the expense of maintenance decreased.

The object of the improvement was to permit the approach to Baltimore, at mean low water, of vessels drawing from 22½ to 23 feet and at ordinary high water of vessels drawing 24 and 24½ feet.

At the close of the last fiscal year operations were suspended from lack of funds. The act of August 11, 1888, appropriated \$300,000, and this amount is now nearly expended, or obligation under contract entered into, and all work contemplated under that appropriation will be completed, probably, by September 1, 1889.

The channel throughout has been excavated to 27 feet at low water. The Craighill Channel below the Cut-off, the Cut-off Channel and the Brewerton above the Cut-off have been excavated to 400 feet width; the Fort McHenry Channel has a least width of 250 feet and there are considerably greater widths at the angles.

Up to June 30, 1889, the United States had expended \$2,359,433.27 with the result indicated above. The city of Baltimore and the State of Maryland, chiefly the former, have also contributed to the same object more than \$500,000.

July 1, 1888, amount available.....	\$4, 025. 49
Amount appropriated by act of August 11, 1888	300, 000. 00
	<hr/> 304, 025. 49

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$155, 831. 60
July 1, 1889, outstanding liabilities.....	18, 500. 00
July 1, 1889, amount covered by existing contracts.....	107, 290. 93
	<hr/> 281, 622. 53

July 1, 1889, balance available	<hr/> 22, 402. 96
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{ Amount (estimated) required for completion of existing project.....	700, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	500, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix I 1.)

2. *James River, Virginia.*—When the improvement of the James River was regularly undertaken by the Government the navigation was obstructed by sunken vessels, by remains of military bridges, and by other obstructions put into the river during the late war to prevent the national fleets from approaching too close to Richmond.

There were also other natural obstructions. Rockett's Reef and Richmond Bar had only 7 feet of water at mean low tide. From Warwick Bar to Richmond the channel was crooked and obstructed by

dangerous rocks and ledges, the Dutch Gap Cut-off was not then open, and the river was in a poor condition as regards its availability for commercial purposes.

The original project of improvement was to secure a depth of 18 feet at full tide (corresponding to about 15 feet at low tide) to Richmond, with a channel width of 180 feet. This project had reached an advanced stage of progress when Congress, by act approved July 5, 1884, adopted the project looking to 22 feet at mean low tide from the sea to Richmond, the width to be 400 feet from the sea to City Point, 300 from thence to Drewry's Bluff, and 200 feet from thence to Richmond.

July 1, 1888, the available balance was \$1,047.98. The additional sum of \$225,000 was provided by the law of August 11, 1888.

At the commencement of the fiscal year all field operations had ceased on account of funds having been exhausted. As soon as money was available a survey was organized to ascertain what was most necessary and pressing to do.

The brush in places in the training-dikes had settled considerably and repairs to such places were made as soon as practicable. Work was continued on the dredging at Stearn's Dike by the dredges rented from the city of Richmond after advertisements had failed to secure satisfactory bids, and upon this work there were removed during the year 7,073.4 cubic yards of sand or gravel, 21,978.6 cubic yards of disintegrated rock, and 4,806.3 cubic yards of solid rock, making a total of 33,858.3 cubic yards of material, together with 205 boulders.

Operations were resumed in dredging over the reach from Richmond Bar, and by contract to Falling Creek, and 475,020 cubic yards of sand, mud, and gravel, 197 boulders, and 20 logs were removed from this section.

Another contract was let, under which three old wing-dams were extended a total of 232.3 feet, seven new ones built, aggregating 999.7 feet in length, and the ends of certain others connected by 9,140.6 feet of training-dikes. The work at Goode's Rocks was again taken up, and, under contract, 421 holes, aggregating 3,061 feet in length, were drilled and blasted; 2,059.6 cubic yards of solid rock and 1,918.7 cubic yards of disintegrated rock were removed to June 30; this contract being about 66 per cent. completed.

Four deck-lighters and a combined hoister and pile-driver were built under contract.

A land-slide at Dutch Gap demanded that some of the material therefrom should be removed to avoid further movement into the already restricted channel, and informal arrangements were made with the owner of a dredge then in the vicinity to undertake the work, and under this arrangement it is expected to remove about 40,000 cubic yards of material at 16 cents per cubic yard, of which 18,776.3 cubic yards had been removed up to July 1.

A freshet occurred on June 2, only exceeded in height by two freshets in forty-two years, and it is gratifying to note that no damage was done to the works.

The condition of the river at the close of the year may be stated as follows:

The available draught from the sea to City Point at high tide was 19½ feet; thence to Kingsland, 18 feet; over Kingsland, 16 feet; thence to Richmond, 16½ feet.

When the proposed improvement is completed an annual expenditure of \$20,000 will be necessary for the maintenance of the channel. The amount that may be advantageously expended during the fiscal

year ending June 30, 1889, is put at \$400,000, less than one-tenth the estimated cost of the adopted project.

The total amount expended on this river by the United States up to June 30, 1888, has been \$939,215.23, which includes the sum of \$208,330.68 expended since the new project has been entered upon to give a depth of 22 feet at mean low water. Amount expended in fiscal year ending June 30, 1889, \$155,324.63.

July 1, 1888, amount available.....	\$1,047.98
Amount appropriated by act of August 11, 1888.....	225,000.00
	<hr/> 226,047.98

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$155,324.63
July 1, 1889, outstanding liabilities.....	5,425.00
July 1, 1889, amount covered by existing contracts.....	23,603.61
	<hr/> 184,353.24

July 1, 1889, balance available.....	41,694.74
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{ Amount (estimated) required for completion of existing project	3,936,070.45
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	400,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix I 2.)

3. *Removing sunken vessels or craft obstructing or endangering navigation.*—The schooner *Wallace M. French*, sunk opposite Leading Point, near Fort McHenry division of channel leading to Baltimore Harbor, was removed by contract, completed May 31, 1889.

(See Appendix I 3.)

IMPROVEMENT OF THE HARBOR AT NORFOLK AND ITS APPROACHES, VIRGINIA; APPROACH TO NORFOLK, VIRGINIA; OF NANSEMOND RIVER, VIRGINIA, INCLUDING MOUTHS OF BENNETT AND CHUCKATUCK CREEKS AND APPOMATTOX RIVER, VIRGINIA; CURBITUCK SOUND, COANJOK BAY, AND NORTH RIVER BAR, NORTH CAROLINA.

Officers in charge: Col. Wm. P. Craighill, Corps of Engineers, to November 22, 1888, since which time Lieut. G. J. Fieheger, Corps of Engineers. Division Engineer, Col. Wm. P. Craighill, Corps of Engineers.

1. *Harbor of Norfolk and its approaches, Virginia.*—The project for improvement adopted in 1877 was to deepen and widen the channel at the mouth of the Southern Branch and along the Berkley and Portsmouth Flats, in the harbor proper, and for the approaches to dredge a channel 500 feet wide and 25 feet deep, at ordinary low water, through the bars at the Western Branch and Sewell's Point.

The revised project of 1885 is as follows: (1) To secure a channel not less than 25 feet deep and 500 feet wide at ordinary low water, by dredging from the deep water of Hampton Roads to Norfolk and the United States Navy-yard on the Southern Branch, and also to secure a channel in the Eastern Branch at the same stage, not less than 22 feet deep, with a width at least 300 feet at the Norfolk and Western Railroad Bridge, and gradually increasing to about 700 feet at its mouth, by dredging between said points; and (2) to ultimately dredge the entire area bounded by lines parallel to and 75 feet from the port-warden lines to a depth not less than 25 feet at ordinary low water, from Fort Norfolk to the United States Navy-yard, and not less than 22 feet

from the mouth of the Eastern Branch to Campostella Bridge, and to construct a bulkhead at Berkley Flats.

With slight modification all operations have been conducted in accordance therewith.

The amount expended to June 30, 1888, was \$433,225, which resulted in a channel at least 200 feet wide and 25 feet deep from Hampton Roads to Norfolk Harbor; a channel of the same depth and 125 to 500 feet wide in the Southern Branch to the United States Navy-yard, and a channel 22 feet deep and 200 feet wide in the Eastern Branch to the Norfolk and Western Railroad Bridge.

The channel thus dredged was in a good condition July 1, 1888, except at Sewell's Point Bar where the ruling depth was reduced to 22½ feet, and at the mouth of the Eastern Branch where it was 20 feet.

There was expended in the fiscal year ending June 30, 1889, \$49,344.91, which was applied to the removal of 360,957 cubic yards of material from Sewell's Point Bar. This dredging resulted in a channel nearly 250 feet wide and 13,500 feet long through the bar.

The establishment of the harbor lines has increased the ultimate amount of dredging called for in the project of 1885.

To complete this work as far as can be foreseen will require the expenditure of \$507,744.56.

July 1, 1888, amount available.....	\$1, 775. 00
Amount appropriated by act of August 11, 1888.....	50, 000. 00
	<hr/>
	51, 775. 00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	49, 344. 91
	<hr/>
July 1, 1889, balance available.....	2, 430. 09
	<hr/>

{ Amount (estimated) required for completion of existing project.....	457, 744. 56
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	100, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix J 1.)

2. *Approach to Norfolk Harbor and the United States (Norfolk) Navy-yard, between Lambert's Point and Fort Norfolk.*—The original condition of this channel was good with the exception of the shoal opposite the mouth of Western Branch, over which there was a navigable depth of 19 feet at ordinary low water.

The project of 1878 was to dredge a channel 500 feet wide and 25 feet deep at ordinary low water the entire length of the shoal, 4,800 feet.

The revised project of 1886 is: (1) To secure a channel, not less than 25 feet deep and 500 feet wide at ordinary low water from Lambert's Point to Fort Norfolk, by the construction of a dike and by dredging. (2) To ultimately widen this channel to within 75 feet of a straight line drawn from Fort Norfolk to the deep water opposite Lambert's Point, 6,800 feet of which is the proposed port-warden's line, making the channel at least 700 feet wide.

From July 5, 1884, to June 30, 1888, there was expended on this improvement \$80,223, which resulted in a channel 400 feet wide and 25 feet deep at ordinary low water, and a channel of the same depth and 600 feet wide from the deep water off Lambert's Point to the port-warden line.

During the year ending June 30, 1889, there was expended on this improvement, including outstanding liabilities and amount covered by

contracts, \$107,692.72, which resulted in a channel at least 700 feet wide and 25 feet deep at ordinary low water from Lambert's Point to Fort Norfolk.

The project of 1886 has been completed with the exception of the dike. cursory examination made during the year indicate some shoaling in the channel dredged in 1885, but not sufficient to warrant the construction of the dike until further observations can be made.

July 1, 1888, amount available	\$107,277.00
Amount appropriated by act of August 11, 1888.....	10,000.00
Amount received from officer for sale of fuel	45.00
	<hr/> 117,322.00

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$81,619.24
July 1, 1889, outstanding liabilities.....	632.50
July 1, 1889, amount covered by existing contracts.....	25,560.87
	<hr/> 107,812.61
July 1, 1889, balance available.....	<hr/> 9,509.39

{ Amount (estimated) required for completion of existing project.....	108,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix J 2.)

3. *Nansemond River, Virginia, including the mouths of Bennett and Chuckatuck creeks.*—In 1872 the navigable channel of the Nansemond River, from Suffolk to Hampton Roads, was 5 feet deep at ordinary low water over the shoals, and was much obstructed by wrecks, piles, snags, etc.

From 1873 to 1878, inclusive, the expenditures made by the United States for the above improvement amounted to \$37,000. The result was a navigable channel 8 feet deep, which is still unimpaired. No work was done between 1880 and 1889.

In obedience to the requirements of the river and harbor act of August 5, 1886, a preliminary examination and survey were made of the river, a report of which is found in Appendix L 13 of the Report of the Chief of Engineers for 1887.

The plan of improvement proposed provides for a channel not less than 100 feet wide at bottom, 12 feet deep at mean low water, from the head of navigation to the mouth of Western Branch, 5.37 miles, including a turning basin 200 feet square, 300 feet below Suffolk Bridge, by dredging and the construction of spurs and training walls; and a channel of like depth from mouth of Western Branch to deep water at Town Point, 200 feet wide at bottom at its upper end, and gradually increasing to at least 400 feet at its lower end, etc.; the total estimated cost being in round numbers \$152,500.

During the fiscal year there has been expended on this work \$119.63. This amount has been applied to contingencies and to the payment of work done under existing contracts. One of these contracts is for repairing the dike at the mouth of the Western Branch, and the other for dredging the shoal near Suffolk. These works will be completed by March 1, 1890.

Preliminary examinations were made of Bennett and Chuckatuck creeks by the engineer in charge. These were reported by him as unworthy of improvement. It is therefore suggested that in future appropriations for the Nansemond River the mouths of Bennett and Chuckatuck creeks be omitted.

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Amount appropriated by act of August 11, 1888.....	\$10,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$119.63
July 1, 1889, outstanding liabilities.....	100.00
July 1, 1889, amounts covered by existing contracts.....	5,889.00
	<hr/> 6,108.63

July 1, 1889, balance available.....	3,891.37
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{ Amount (estimated) required for completion of existing project.....	132,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	15,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix J 3.)

4. *Appomattox River, Virginia.*—At the close of the late war the navigation of this river was in such a condition that the depth of water on more than one of the shoals did not exceed 6½ feet at high tide, and this depth was diminished by 3 feet at low tide. The plan of improvement adopted in 1870 was to attain a depth of 12 feet at high tide, with as much width of channel as the river would bear. This plan has been steadily adhered to, constant progress being made towards its completion from year to year by the use of the money granted by Congress. The means depended on have been revetments, jetties, dams, and training-walls, with resort to the dredge only when the needs of commerce required immediate work in the channel to give more width or depth than had been attained under the slower operations of the structures mentioned, of which the system has not yet been fully carried out for want of sufficient funds. Puddledock Cut, 2 miles long, has been enlarged, and the river was diverted from old channel into it.

The amount expended by the United States up to June 30, 1888, on the project adopted in 1870, \$378,690.05, resulted in securing a turning-basin at Petersburg about 155 by 110 feet, and a navigable channel of 12 feet and upwards at high tide, with some short shoals remaining, from Petersburg down to Point of Rocks, all of which greatly benefited navigation.

During the fiscal year there has been expended \$9,678.99 on this improvement. This was applied to the relief of commerce by dredging three shoals formed by the annual freshets of 1888, to the repair of existing works, and to the construction of jetties to permanently remove the shoal at Gatlings. An aggregate of 15,175 cubic yards of material was removed from the shoals. All the jetties and dikes outside the city limits were thoroughly repaired. Twenty-two jetties, having an aggregate length of 3,088 feet, were constructed at Gatlings' shoal.

The navigable depth of the river over all shoals for the year was about 10½ feet. A freshet, 6½ feet higher than any previously known, occurred on June 1. It carried away all but one of the bridges over the river near Petersburg and did much damage to mills and warehouses. No injury was done to any of the jetties or dikes, and only three short shoals were formed in the river below the city. The least depth over these was 7½ feet. A shoal was formed near the city wharves with only 5½ feet of water over it, and some of the city jetties were injured.

All work within the city limits has been done by the city of Petersburg, which keeps a dredge for this purpose.

Report on the examination and survey, with estimate of cost, for diverting the water of the river above the harbor at Petersburg to the

old north channel, made to comply with requirements of the river and harbor act of August 11, 1888, is submitted with this report.

July 1, 1888, amount available	\$59.95
Amount appropriated by act of August 11, 1888	15,000.00
	<hr/> 15,059.95
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 18-8	\$9,678.99
July 1, 1889, outstanding liabilities	248.19
	<hr/> 9,927.18
July 1, 1889, balance available	5,132.77
	<hr/>
{ Amount (estimated) required for completion of existing project	30,080.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	20,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix J 4.)	

5. *Currituck Sound, Coanajok Bay, and North River Bar, North Carolina.*—Previous to the commencement of this improvement there was an indifferent natural channel with a depth of from 5 to 7 feet at low water, which had been partially dredged, in the sound and bay, by the Albemarle and Chesapeake Canal Company.

The original project, adopted in 1878, is to obtain a channel 80 feet wide at bottom and 9 feet deep at ordinary winter water, by dredging the entire length of the sound, 10½ miles, to which was added, in 1880, the project to prolong this channel by dredging through the bay about 2 miles, and to construct a shell dike 9,600 feet along the westerly side of the channel through the latter, to maintain it. In 1885 it was further enlarged by the project to dredge a straight channel through North River Bar 7,150 feet long, 150 feet wide, and 9.4 feet deep at ordinary low water.

The amount expended to June 30, 1888, is \$134,685.68, and resulted in the construction of the dike and a channel in the sound and bay from 40 to 80 feet wide, the entire length and depth proposed, all of which greatly improved navigation and increased the commerce over this route.

The entire channel was surveyed last in April and May, 1885, to ascertain its condition, which was found to be quite good, although shoal in places. This is probably due very largely to steamers grounding out of the channel and creating shoals in their efforts to get off. To restore and complete the work will require the removal of 215,075 cubic yards of material measured in place.

There has been expended on this work during the fiscal year \$319.23, which has been applied to contingencies.

This improvement is on the important inland water route connecting Chesapeake Bay and Albemarle Sound. The other waters of the United States on this route are the Elizabeth, North Landing, and North rivers; the first two were under improvement until a channel 80 feet wide and 9 feet deep was obtained.

During the last year there has been much complaint made of the sunken and floating logs which impede navigation in all these waters. To provide for their removal, it is recommended that future appropriations be made available for Elizabeth, North Landing, and North rivers, Currituck Sound, and Coanajok Bay, under the designation "Inland water route from Norfolk Harbor, Virginia, to Albemarle Sound, North Carolina, through Currituck Sound."

If steps are taken to prevent the owners of rafts from abandoning logs in these waters, the entire route can be kept open at a small annual cost.

July 1, 1888, amount available	\$314.32
Amount appropriated by act of August 11, 1888	7,500.00
	<hr/>
	7,814.32
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	319.28
July 1, 1889, balance available	7,495.04
	<hr/>

{ Amount (estimated) required for completion of existing project	39,885.68
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	20,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866, and 1867.	

(See Appendix J 5.)

6. *Removing sunken vessels or craft obstructing or endangering navigation.*—On April 6, 1889, the officer in charge reported that the wreck of the bark *Pettingill* was lying in the channel leading from the Atlantic Ocean to Hampton Roads and was an obstruction to navigation of the character contemplated by section 4, act of June 14, 1880. Its removal was therefore authorized by the Secretary of War. Having been duly advertised, bids have been invited for its removal. These bids will be opened July 30, 1889.

(See Appendix J 6.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examinations of the following localities were made by the local engineer in charge, Lieutenant Fiebeger, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers concurring in the conclusions reached in these instances, has given no instructions to make further survey with the view to their improvement:

1. *For cutting of Hospital Point, Virginia, and giving a depth of twenty-five feet and an additional width of two hundred feet*—(See Appendix J 7.)

2. *Chuckatuck Creek, Virginia.*—(See Appendix J 8.)

3. *Bennett's Creek, Virginia.*—(See Appendix J 9.)

The required preliminary examination of *Hampton Creek and Bar, Virginia*, was made by the local engineer, Lieutenant Fiebeger, and reported by him as worthy of improvement, and this conclusion being concurred in by the Chief of Engineers, the result of the preliminary examination containing information sufficient to indicate to Congress the probable cost of the work required, no further report or survey appeared to be necessary. The improvement recommended is a continuation of that hitherto undertaken to give a channel 200 feet wide and at least 9 feet deep at mean low water from the mouth of the creek to Hampton Bridge, and a channel of same depth through the bar with a width of 200 feet at the mouth of the creek and 300 feet at the turning buoy; estimated cost \$10,000.

(See Appendix J 10.)

IMPROVEMENT OF THE POTOMAC RIVER AT WASHINGTON; RECONSTRUCTION OF THE AQUEDUCT BRIDGE AT GEORGETOWN, AND CONSTRUCTION OF BRIDGE ACROSS THE EASTERN BRANCH OF THE POTOMAC AT WASHINGTON.

Officer in charge, Lieut. Col. Peter C. Hains, Corps of Engineers.

1. *Potomac River at Washington, District of Columbia.*—Before the improvement was commenced the channel to Georgetown was narrow, crooked, and had not sufficient depth to accommodate commerce. Vessels drawing 16 feet frequently grounded at high water above Long Bridge, and to maintain this depth frequent dredging was necessary, and even then the channel was narrow, as the appropriations for dredging were only sufficient to make a narrow cut through the bar. The Washington Channel was not only shoal, but narrow, and wholly inadequate to the wants of commerce.

The flats in front of the city were large in area, sometimes covered, sometimes not covered, by the water of the river, which was polluted by the mixture of the sewage of a large city. The sewer at the foot of Seventeenth Street discharged its contents on the flats, rendering some parts of the city in that vicinity very unhealthy. By act passed August 2, 1882, Congress adopted a project which had for its object the improvement of the navigation of the river by widening and deepening its channels, the establishment of harbor lines beyond which no obstructions should be built, and at the same time the filling of the flats or marshes on the city front, so that they would not be overflowed by ordinary high tides, the material to be dredged from the channels to be used in filling the flats.

The project provides for such depth of channels as will accommodate the largest class of vessels that can reach Arsenal Point, with such additional depth at the wharves as will enable vessels to receive full cargoes without grounding at low water; for filling the flats above Long Bridge to a height of 3 feet above the flood-slope of 1877, and that part of the flats below Long Bridge to the same height along the middle line, but sloping on each side of it to 6 feet above mean low tide at the margin; that in order to purify the water of the Washington Channel, which will be cut off at the upper end from the Virginia Channel, a tidal reservoir or basin be established between the sewer canal and Long Bridge, this reservoir to be filled by water from the Virginia Channel on the flood tide, and discharged into the Washington Channel on the ebb. The plan also contemplated the removal of Long Bridge or its rebuilding with longer spans during the progress of the work, and the interception of all sewage now discharged into the Washington Channel, and its conveyance to the James Creek, but neither the reconstruction of the bridge nor the building of the intercepting sewer were included in the estimated cost of the improvement.

The amount expended up to the close of the fiscal year ending June 30, 1888, is \$1,247,494.90. At that time the Washington Channel had a depth of 20 feet at mean low tide, and a width of 350 feet; the Virginia Channel below Long Bridge had a depth of 20 to 24 feet at mean low tide, and width of 350 to 500 feet; the same channel above Long Bridge had a depth of about 17 feet at mean low tide, and width of about 550 feet. This part of the channel had originally been dredged to 20 feet, but had partly filled up by the deposit of material brought down in freshets. Of the total area of the flats 544 acres had been raised above overflow at ordinary high tide, some of which was up to grade, and of the total amount of material needed to fill them to the

required grade a little more than one half had been deposited on them. About three fourths of the tidal reservoir had been dredged, and the foundation of the outlet constructed. The expenditures of the past year have been devoted to the improvement of navigation by widening the Washington Channel at its lower end, and removing the shoal at its junction with the Virginia Channel, so that the distance from the wharves along the river-front below Long Bridge to Georgetown has been materially shortened, the material so dredged being deposited on the lower end of Section III; to raising the embankments along the margin of the fill wherever necessary, and along the sewer-canal, protecting the same by means of riprap, and continuing the construction of the reservoir outlet. The latter work has been one of exceptional difficulty owing to the great depth of soft material comprising the bed of the river at its site.

On the 2d of June there occurred the greatest freshet in the Potomac River of which there is any authoritative record. The Potomac at Harper's Ferry rose to the height of 34 feet above the low stage. The water was at one time 2.8 above the rails of the Baltimore and Ohio Railroad on the bridge, and 6.8 higher than the freshet of 1877. The freshet attained its maximum height at about 10 a. m. on June 2. It was within 3 feet of that height for a period of about twenty-four hours, and within 6 feet of it for about thirty hours. The highest point reached by the water at the Sewer Canal, at the foot of Seventeenth street, was 13.26 feet.

The actual damage to the reclaimed land on the river front was not great. Section I was protected by a heavy growth of willows which retarded the flow of water over it. The water swept over Section II from near the mouth of the Sewer-Canal toward the Washington Channel with considerable velocity, and as the material consists largely of sand many cubic yards were washed into the tidal reservoir. Section III was not badly damaged, as the current below Long Bridge was not nearly so swift. Considerable lumber and tools were lost at the Reservoir Outlet, but the masonry of that structure was not damaged; \$25,000 would cover the loss by washing away of material from the flats.

The channels of the river, however, suffered considerably. The Virginia Channel above Long Bridge was filled up to such an extent that there is now not more than 14 feet in many places where there was 20 feet. Recent examinations have been made and from them it is estimated that not less than 600,000 cubic yards of material have been deposited in the dredged channel above Long Bridge. Perhaps one-third of this amount was the deposit of prior freshets, there having been a number of them since the channel was dredged to 20 feet. The same channel below Long Bridge did not fill up to any great extent, except at its junction with the Washington Channel, where a deposit of about 3 feet took place. At the upper end of the Washington Channel there was a deposit of about 4 feet, which fell off to nothing at the upper end of the Arsenal Grounds. In the Tidal Reservoir the deposit varies from about 4 feet in some places to less than 1 foot in others. It is estimated in round figures that there was not less than 1,000,000 cubic yards of material brought down the river and deposited in places where it is injurious to the channels of the river and will have to be removed in order to restore them to the condition they were in prior to the freshet.

Long Bridge.—The necessity of early action in respect to the rebuilding of Long Bridge is emphasized by this freshet. Had it occurred when the river was full of ice a gorge would in all probability have formed at the bridge, which would have thrown much more water into

the city and done a much larger amount of damage. Attention has often been called to the necessity of rebuilding Long Bridge, and this necessity increases as the work advances. To delay it longer is to put vast interests in jeopardy.

July 1, 1888, amount available.....	\$23, 124. 70
Amount appropriated by act of August 11, 1888.....	300, 000. 00

323, 124. 70

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$174, 208. 70
July 1, 1889, outstanding liabilities.....	17, 188. 87
July 1, 1889, amount covered by existing contracts.....	81, 743. 39

July 1, 1889, balance available.....	52, 303. 74
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{ Amount (estimated) required for completion of existing project.....	1, 141, 365. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891.....	600, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix K 1.)

2. *Reconstruction of the Aqueduct Bridge, Georgetown, District of Columbia.*—Congress by act approved June 21, 1886, appropriated the sum of \$240,000 for the purchase of the Aqueduct Bridge, an unsafe wooden structure over the Potomac, and its approaches, and the construction of a free bridge upon the existing piers. The work was assigned to Lieutenant-Colonel Hains in December, 1886. At the close of the year ending June 30, 1888, the work of reconstruction was about completed, and the new bridge was open to public travel. The operations during the past year consisted of the execution of minor details necessary to a completion of the project. On September 15, 1888, the custody of the bridge was transferred to the District Commissioners in compliance with a requirement of the District appropriation act of July 18, 1888.

The matter of the condemnation of the north abutment has been adjudicated, the amount to be paid by the United States being fixed at \$10,000.

July 1, 1898, amount available.....	\$11, 128. 86
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$5, 242. 28
July 1, 1889, outstanding liabilities.....	10, 000. 00

July 1, 1889, balance available.....	7. 33
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(See Appendix K 2.)

3. *Bridge across the Eastern Branch of the Potomac River, District of Columbia.*—This bridge is located at the foot of Pennsylvania avenue, southeast, in the District of Columbia. It was authorized by act of Congress approved February 23, 1887, by which an appropriation of \$110,000 was made. On September 20, 1887, a contract for the construction of an iron bridge resting on masonry piers was made with the Groton Bridge and Manufacturing Company of Groton, New York. The total price being \$105,000. The original plan provided for a 90-foot through span at the west end of the bridge, over the tracks of the Baltimore and Potomac Railroad Company. When the contractors commenced the excavation for the foundation for the west abutment, they were forcibly interfered with by the railroad company, which claimed that the abutment encroached upon the company's right of way. Subsequently the railroad officials expressed a desire to move their tracks about 187 feet to the eastward of their existing location.

By act approved May 14, 1888, Congress authorized the Secretary of War to make such changes in the plan of the bridge as would best accommodate the traffic over and under it, and appropriated \$60,000 to provide for the cost, coupling therewith a proviso that the railroad company should pay its fair and just proportion of the cost of the changes at the west end of the bridge. It was difficult to fix upon modifications acceptable to the Government and to the railroad company, and which the contractors would agree to adopt for a reasonable price, and at the close of the fiscal year, 1888, operations were practically at a stand. In July, 1888, however, the matter was adjusted, and a supplemental contract made with the Groton Company for the erection, at the west end of the bridge, of two through spans of 151 feet each, in place of one 90-foot through span and two 112-foot deck spans as originally designed. The additional price to be paid the contractors is \$40,000.

At the close of the year ending June 30, 1889, nine iron deck spans were erected and their piers completed, the embankment for the eastern approach was nearly completed, and the contractors were engaged in the construction of the two 151-foot through spans and the piers which are to support them. The west abutment was nearly completed.

July 1, 1888, amount available	\$ 1, 154. 74
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$45, 198. 10
July 1, 1889, outstanding liabilities.....	8, 704. 47
July 1, 1889, amount covered by existing contracts.....	80, 455. 56

July 1, 1889, balance available	15, 846. 76
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(See Appendix K 3.)

EXAMINATION AND SURVEYS FOR IMPROVEMENT TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examinations of the following localities were made by the local engineer in charge, Lieutenant-Colonel Hains, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers concurring in the conclusions reached in these instances, has given no instructions to make further survey with the view to their improvement:

1. *Eastern Branch of the Potomac River, Maryland.*—(See Appendix K 4.)
2. *South Branch of the Potomac River, West Virginia.*—(See Appendix K 5.)
3. *Great Cacapan River, West Virginia.*—(See Appendix K 6.)

IMPROVEMENT OF PATUXENT RIVER AND OF THE HARBORS OF BRETON BAY AND ST. JEROME'S CREEK, MARYLAND—OF THE CHANNEL AT MOUNT VERNON—OF RAPPAHANNOCK RIVER AND YORK RIVER, VIRGINIA—OF TRIBUTARIES OF THE LOWER POTOMAC AND OF CERTAIN RIVERS IN VIRGINIA AND NORTH CAROLINA.

Engineer in charge, Mr. S. T. Abert, United States Agent; division engineer, Col. William P. Craighill, Corps of Engineers.

1. *Patuxent River, Maryland, from Benedict to Hill's Landing.*—Two only of the five bars between Benedict and Hill's Landing have been surveyed. These are Swann's Point and Bristol bars, respectively, 43 and 46 miles from the mouth of the river. At Swann's Point Bar the least

depth within the limit of the proposed channel was found to be 7.2 feet at low water. At Bristol Bar the least depth was 4.7 near the county wharf.

Steam navigation on both bars is impeded at low water.

The improvement consists in dredging a cut 200 feet wide and from 12 to 13 feet deep, which will give, when completed, a channel of about 100 feet wide and 12½ feet deep at low water.

Bids received for dredging were excessive (probably on account of the small appropriation and the difficulty of finding convenient dumping-grounds) and were rejected.

An attempt will be made in the autumn to secure reasonable bids.

Up to June 30, 1889, \$255.29 has been expended.

Amount appropriated by act of August 11, 1888	\$5,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	255.29
July 1, 1889, balance available	<u>4,744.71</u>

{ Amount (estimated) required for completion of existing project	75,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 1.)

2. *Channel at Mount Vernon, Virginia*—Previous to the commencement of this improvement there was a depth of but 4 feet at low water over the wide flat between the wharf at Mount Vernon and the main channel of the Potomac River, a distance of 1,900 feet. The present project, adopted in 1879, and amended in 1883, is to excavate a channel from deep water of the Potomac to the wharf at Mount Vernon which shall have when completed a width of 200 feet and a depth of from 9 to 10 feet at low water, with a turning-basin of 200 feet radius.

The amount expended to June 30, 1889, is \$13,971.44.

The channel has been dredged a distance of 2,300 feet from the wharf to the main channel of the Potomac. It has a width varying from 60 to 100 feet, and the basin a width of 360 feet.

The depths in the channel and basin within the limits mentioned vary from 9 to 12.8 feet.

As stated in the Report for 1888, no instrumental examination has been made from 1881 to June 30, 1888. The superintendent of Mount Vernon reported that the channel had filled about 10 per cent. (in depth). Upon this representation was based the statement that \$8,500 would complete the improvement.

A survey under the last appropriation showed that the basin was nearly obliterated, and that the work required to complete the channel would be increased by the deposit.

Amount appropriated by act of August 11, 1888	\$6,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$5,466.44
July 1, 1889, outstanding liabilities	5.00
	<u>5,471.44</u>
July 1, 1889, balance available	<u>528.56</u>

{ Amount (estimated) required for completion of existing project	2,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	2,500.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 2.)

3. *Breton Bay, Leonardtown, Maryland.*—The harbor of Leonardtown, at the upper end of Breton Bay, prior to the commencement of the present improvement, had a least depth of 5 feet at low water, which was insufficient for the passage of steamers to and from Leonardtown Wharf.

The bar which was assumed to extend to the 9-foot curve in the bay was about 1 mile in length.

The original project submitted in 1875 provided for a channel 150 feet wide, with enlargement to 400 feet in the widest part at the turn, and turning ground at the wharf of maximum width of 430 feet and length of 770 feet, depth 9 feet at mean low water.

In 1885 it was proposed to widen the cut to 200 feet for a distance of $1\frac{1}{2}$ miles, and to enlarge the basin to a width of 400 feet by 800 feet in length, depth in channel and basin not to be less than $10\frac{1}{2}$ feet. The effect of the increased dimensions would be to preserve the navigable width of the channel.

The amount expended to June 30, 1888, was \$29,173.96.

A basin was dredged 980 feet long by 370 wide, at the upper end; and thence a channel was dredged 150 wide for a distance of 1,870 feet, and 185 feet wide for a further distance of 1,420 feet.

The depths varied from 8.5 feet to 13.3 at low water. This describes the channel up to June 30, 1888.

During the year ending June 30, 1889, \$2,486.06 was expended in excavating 13,141 cubic yards of material at the rate of $13\frac{1}{2}$ cents.

The total cost of the work to June 30, 1889, is \$31,660.02.

The channel was widened at the turn 80 feet for a distance of 480 feet and 95 feet for a distance of 605 feet.

The dimensions above the turn are the same as in 1888. At the turn the width varies from 185 to 280 feet, and the depths from $8\frac{1}{2}$ feet to 14.6 feet at low water.

July 1, 1888, amount available	\$326. 04
Amount appropriated by act of August 11, 1888	3, 000. 00
	<hr/> 3, 326. 04
July 1, 1889, amount expended during fiscal year, exclusive of	
liabilities outstanding July 1, 1888	\$2, 483. 56
July 1, 1889, outstanding liabilities	2. 50
	<hr/> 2, 486. 06
July 1, 1889, balance available	839. 96
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{ Amount (estimated) required for completion of existing project	17, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 3.)

4. *Nomini Creek, Virginia.*—This stream is an important tributary of the Potomac, 82 miles below Washington, draining a large area of productive country.

Navigation was obstructed by a bar of sand and oyster shells at its mouth, over which but 3 feet could be carried at low water, and the dangers and difficulties of passing the bar were further increased by a cross-tide and an exceedingly rapid current.

After passing the bar $8\frac{1}{2}$ feet can be carried to Nomini Ferry, 3 miles above the mouth.

The original project for the improvement was adopted in 1873, the object being to excavate a channel through this bar 100 feet wide and 9 feet deep at low water.

In 1879 the project was modified to provide for a width of 150 feet in the channel. The large increase of trade which followed the opening of the new channel called for an amended project, which was submitted in 1882.

This amendment consisted in the enlargement of the width to 200 feet, and the dredging of a tidal supply channel and the sinking of mats to divert cross-currents which obstruct navigation and tend to fill the main channel. The appropriations have been barely sufficient to keep the channel navigable, and it is difficult and dangerous at night and during the prevalence of northeast and northwest winds.

The amount expended to June 30, 1888, was \$32,500. At the close of the work in 1883, a channel was dredged 100 feet wide and 9 feet deep from the 9-foot curve outside the entrance to the creek to White Oak Point, a distance of 4,400 feet.

No dredging was done from 1883 to 1889.

During this interval this cut was reduced in width and depth by deposits of sand at several places, and the channel has shoaled to the depth of $7\frac{2}{3}$ feet above the upper end of the cut.

During the year ending June 30, 1889, \$4,310.80 was expended, which re-opened a channel 94 feet wide through a sand, shell, and gravel bar lying at the mouth of the creek for a distance of about 1,470 feet. The depths in this cut vary from 8.9 feet to 13.8 feet at mean low water.

From the beginning of operations to June 30, 1889, \$36,810.80 has been expended.

Amount appropriated by act of August 11, 1888.....	\$5,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$3,615.57
July 1, 1889, outstanding liabilities.....	695.23
	<hr/>
	4,310.80
July 1, 1889, balance available	689.20
	<hr/>

{ Amount (estimated) required for completion of existing project.....	35,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 4.)

5. *Harbor at entrance of St. Jerome's Creek, Maryland.*—The outer bar in the bay has a length of 2,193 feet from the 9-foot curve in the bay to Corsey's Point in the creek. The least depth of water on it before improvement was 2.8 feet; the average depth in the channels to the ponds used by the Fish Commission for hatching oysters was half a foot. The length of the inner channel to the wharf of the Fish Commission is 3,742 feet.

The project for the improvement of this harbor was adopted in 1881, and contemplated dredging a channel 100 feet wide and 9 feet deep at low water through the outer bar at the mouth of the creek, and a channel 40 feet wide and 6 feet deep through the south prong of the creek, the material therefrom to be thrown up in a dike so as to form a pond for the purposes of the United States Fish Commission. The channel through the outer bar was made navigable and the ponds were formed. The preservation of the depth on the outer bar is doubtful. The United States Fish Commission has abandoned the station. This harbor is situated at a desirable point for a refuge for oyster boats.

Up to June 30, 1889, \$25,635.11 was expended.

July 1, 1888, amount available	\$1,361.40
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	496.51
July 1, 1889, balance available.....	864.89
{ Amount (estimated) required for completion of existing project.....	26,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix L 5.)	

6. *Rappahannock River, Virginia.*—The principal obstructions to navigation before the improvement were Fredericksburg Bar, having a depth at low water of 4 feet, and Spottswood bar, 6 miles below Fredericksburg, having a depth of 6 feet, besides five bars having depths of about 8 feet, within the distance of 12.6 miles below Fredericksburg, and two bars between Port Royal and Tappahannock, at distances of about 33 and 61 miles from Fredericksburg, having depths of about 9 feet.

The project for the improvement was adopted in 1871 and was modified in 1879. It provides for a channel 150 feet wide and 10 feet deep at Fredericksburg Bar; channels 100 feet wide and 10 feet deep through the bars between Fredericksburg and Port Royal, 30 miles below, and channels 200 feet wide and 15 feet deep through the two bars between Port Royal and Tappahannock, where a larger class of vessels must be provided for.

Between March 3, 1871, and June 30, 1879, \$90,500 was expended upon the first project.

The amount expended upon the present project from June 14, 1880, to June 30, 1888, is \$96,642.44. At that date the channel-depth for 12.6 miles below Fredericksburg, the distance improved, was not less than 8 feet at low water, and the width about 100 feet. Below this steamers have less difficulty in navigating the river.

The amount expended during the fiscal year ended June 30, 1889, was \$2,943.62, making the total expenditure upon the present project to that date, \$99,586.06.

The expenditure in 1889 was mainly for removing snags, repairing dikes, and protecting the banks. The condition of the channel as to depth and width is about the same as on June 30, 1888.

July 1, 1888, amount available	\$357.56
Amount appropriated by act of August 11, 1888, \$15,000, less \$3,000 for Urbana Creek	12,000.00
	12,357.56
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	2,769.28
July 1, 1889, outstanding liabilities	174.34
July 1, 1889, amount covered by existing contracts.....	7,000.00
	9,943.62
July 1, 1889, balance available	2,413.94
{ Amount (estimated) required for completion of existing project.....	179,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	30,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Rappahannock River, Virginia, at Urbana Creek, a tidal tributary thereof.—Before improvement the navigation was obstructed by a bar at the mouth, over which but 6 feet of water could be carried.

The present project was adopted in 1879. It provided for a channel through the bar 150 wide and 10 feet deep at low water.

The plan was extended in 1883 to include the removal of a bar in the harbor, and in 1888 to provide for the addition of works intended to prevent the dredged channels from filling.

The amount expended to June 30, 1888, is \$15,500. A channel 120 feet wide and 10 feet deep was excavated through the bar at the mouth, and the bar in the harbor was excavated to a depth of 10 feet and a width of from 80 to 300 feet.

On June 30, 1888, the channel through the bar at the mouth had filled in on one side so that its width was reduced from 120 to 90 feet. The depth remained 10 feet.

There was expended during the year ending June 30, 1889, in examination and preparation for resuming work, \$150, making a total of \$15,650 expended to June 30, 1889.

The condition remained about the same as on June 30, 1888.

Amount appropriated by act of August 11, 1883.....	\$3,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	150.00
July 1, 1889, balance available	2,850.00

{ Amount (estimated) required for completion of existing project.....	16,080.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	5,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 6.)

7. Totusky River, Virginia.—The obstructions to the navigation of this river consisted of two bars, one at its mouth, which forms a part of the wide flat between the outlet of the river and the navigable channel of the Rappahannock, having a least depth of $4\frac{1}{2}$ feet, and the other about $2\frac{1}{2}$ miles above the mouth, known as Booker's Bar, having a ruling depth of 3 feet.

Ten thousand dollars was appropriated up to August 2, 1882. This sum has been expended in building and repairing a longitudinal dike 2,117 feet in length, the effect of which has been to scour out the channel to a depth of $3\frac{1}{2}$ feet at low water.

{ Amount (estimated) required for completion of existing project.....	\$12,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 7.)

8. Mattaponi River, Virginia.—This stream empties into the York River at West Point, Va.

It is navigable at low water as far as Walkerton, 40 miles above West Point, for vessels drawing 9 feet; small steamers can go as far as Aylett's, 12 miles further, and it can be made navigable for barges to Mundy's Bridge, 26 miles above Aylett's. Previous to the commencement of the improvement the river was obstructed by three or four bars, and by snags, wrecks, and overhanging trees.

The original project for the improvement of this river, based on a reconnaissance in 1875, was adopted in 1880, the object being to provide a channel 40 feet wide and $5\frac{1}{2}$ feet deep at low water, by the removal of snags, drift, wrecks, and overhanging trees, and by dredging through bars.

In 1881 an examination was made of the changes which had taken place in Robinson's, Latané's, and Line Tree bars, and in 1885 the project was amended to authorize the construction of dikes at Robinson's and Latané's bars, to preserve channels to be dredged with a bottom width of 40 feet and depth of 6 feet.

The amount expended to June 30, 1888, was \$13,183.30. This sum was expended in snagging operations and the removal of wrecks, logs, and overhanging trees from Mundy's Bridge to near Robinson's Bar, a distance of about 34 miles, and in the construction of a portion of the dikes proposed at Robinson's Bar.

In 1883 the snags, drift, overhanging trees, and wrecks had been removed from Mundy's Bridge to Aylett's, a distance of about 24 miles. No work has been done on this portion of the river since that date, and it is probable that obstructions have accumulated.

In 1888 snags, drift logs, stumps, and trees were removed from Aylett's to Robinson's Bar, a distance of about 10 miles. This portion of the river was not seriously obstructed by snags and trees on June 30, 1888. Some trees obstruct navigation below Indiantown, otherwise navigation is believed to be unimpeded as far as West Point.

During the year ending June 30, 1889, \$1,046.54 has been expended in the construction of dikes at Robinson's Bar. The total amount expended to June 30, 1889, is \$14,229.84.

July 1, 1888, amount available.....	\$116. 70
Amount appropriated by act of August 11, 1888.....	3, 000. 00
	<hr/> 3, 116. 70
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$720. 71
July 1, 1889, outstanding liabilities.....	325. 83
	<hr/> 1, 046. 54
July 1, 1889, balance available	<hr/> 2, 070. 16
{ Amount (estimated) required for completion of existing project.....	23, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix L 8.)	

9. *Pamunky River, Virginia.*—The distance from Hanover town to West Point is 59 miles. The least depth from Hanover town to New Castle Ferry, 8 miles, is $1\frac{1}{2}$ feet. From New Castle Ferry to Piping Tree, a distance of 8 miles, two bars only require improvement at present; these are Skidmore's, $11\frac{1}{2}$ miles below Hanover town, with a least depth of 5.8 feet, and Spring Bar, $15\frac{1}{2}$ miles below Hanover town, with a least depth of 5 feet. Over all the bars as far as White House (about 29 miles above West Point) $12\frac{1}{2}$ feet (nearly) can be carried.

The present project was adopted in 1880, the object being to provide a channel 40 feet wide and from 3 to 5 feet deep from Hanover town to New Castle Ferry, a distance of 8 miles, and 100 feet wide and 7 feet deep at low water at Skidmore and Spring Bars.

The amount expended to June 30, 1888, is \$12,400.97, and during the fiscal year ended June 30, 1889, \$241.05 has been expended, making a total to June 30, 1889, of \$12,642.02.

The only bid received for dredging under the appropriation of August 11, 1888, was rejected on account of certain conditions imposed therein. The work will be readvertised in the autumn, when it is thought that reasonable bids may be obtained.

July 1, 1888, amount available	\$39. 03
Amount appropriated by act of August 11, 1888.....	3,000. 00
	<hr/> 3,099. 03
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$240. 57
July 1, 1889, outstanding liabilities.....	. 48
	<hr/> 241. 05
July 1, 1889, balance available	2,857. 98
	<hr/>
{ Amount (estimated) required for completion of existing project.....	13,000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	8,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix L 9.)	

10. *York River, Virginia.*—The Pamunky and Mattaponi rivers unite at West Point to form the York River, which follows a southeasterly course for 41 miles and empties into Chesapeake Bay. Its average width as far as Yorktown, a distance of 26 miles, is $1\frac{1}{2}$ miles.

Prior to the commencement of the present improvement the navigation was obstructed by two bars; one at West Point, 2.1 miles in length, with a ruling depth of $15\frac{1}{2}$ feet at low water; the other at Potopotank Creek, $8\frac{1}{2}$ miles below, with a ruling depth of $18\frac{1}{2}$ feet at low water. With the exception of these two bars the depth of the channel was not less than 20 feet.

The original project for the improvement of the river was adopted in 1880, the object being to provide a channel 22 feet deep at low water and 400 feet wide through both bars, and also a basin of the same depth opposite the wharves at West Point, and connecting with the channel.

Since the commencement of the work in 1880 the trade at West Point has largely increased and the depth of 22 feet at low water in the channel does not answer the present demands of navigation.

Steamers now load at West Point drawing 24 feet.

During the progress of the work in 1889 the Secretary of War directed (January 4, 1889), at the request of the agents of the Piedmont Air Line Company (Richmond and Danville Railroad), that the project be modified to authorize, under the contract with the American Dredging Company, the deepening of the channel to admit the passage at low water of vessels drawing 24 feet.

The amount expended to June 30, 1888, is \$95,348.62, which provided:

(1) A channel through West Point Bar for a distance of 11,300 feet with a width varying from 100 to 230 feet and with a depth varying from 17.8 feet to 25.6 feet at low water; and

(2) A channel through Potopotank Bar 105 feet wide with a depth of 22 feet at low water. The only dredging at this bar was done in 1881.

These channels have not the width nor depth sufficient to accommodate the present trade of York River, and freight brought by rail to West Point to be shipped to foreign ports.

During the year ending June 30, 1889, \$30,962.33 was expended at the West Point Bar, which gave a channel through the bar of a width varying from 161 feet to 257 feet, and a depth, exclusive of the center cut, of 22 feet at mean low water.

Under the modification of the project by the Secretary of War, a cut 40 feet wide, in the center of the channel, and 24 feet deep was dredged through the bar.

The total amount expended to June 30, 1889, is \$126,310.95.

July 1, 1888, amount available.....	\$3,401.38
Amount appropriated by act of August 11, 1888.....	30,000.00
	<hr/> 33,401.38
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$30,899.83
July 1, 1889, outstanding liabilities.....	62.50
	<hr/> 30,962.33
July 1, 1889, balance available.....	<hr/> 2,439.05
<hr/>	
{ Amount (estimated) required for completion of existing project.....	127,250.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	50,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix L 10.)	

11. *Chickahominy River, Virginia.*—Before improvement the obstructions below Windsor Shades consisted of three bars near that point, upon which the depth was from 4 to 5 feet at low water, and a bar at the mouth of the river upon which the depth at low water was from 11 to 12 feet. The project for improvement, as amended in 1882, provides for dredging channels from 100 to 150 feet wide through Windsor Shades, Old Fort and Binn's bars, to a depth of not less than 8 feet at low water, and for dredging a channel through the bar at the mouth with a width of 200 feet and a depth of from 14 to 15 feet at low water.

Up to June 30, 1888, \$19,000 had been expended. Channels of the required width and depth were dredged through the bar at the mouth and at Windsor Shades, and also for portions of the distance through the bars at Old Fort and Binn's. The channels at Windsor Shades and Old Fort had been reduced in width on June 30, 1888, to about 75 feet by filling at the sides, and the channel at Binn's Bar had narrowed to about 160 feet. The depths remained about as dredged, except at Old Fort Bar, which had filled to some extent.

There was expended during the year ending June 30, 1889, \$1,927.12, making a total of \$20,927.12 to that date. During the fiscal year ending June 30, 1889, a continuation of the channel at Binn's Bar was dredged to a depth of 9 feet for a width of 60 feet and a length of 1,500 feet; and a continuation of the channel at Old Fort Bar was dredged to a depth of 9 feet for widths of 30 and 60 feet and a length of 800 feet. Work was still in progress at the close of the fiscal year.

Amount appropriated by act of August 11, 1888.....	\$2,500.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$400.31
July 1, 1889, outstanding liabilities.....	1,526.81
July 1, 1889, amount covered by existing contracts.....	95.06
	<hr/> 2,022.18
July 1, 1889, balance available.....	<hr/> 477.82
<hr/>	
{ Amount (estimated) required for completion of existing project.....	7,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	5,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix L 11.)	

12. *Staunton River, Virginia.* (a) *Between Brook Neal and Randolph.*—Prior to improvement the river could be navigated only by bateaux drawing about 1 foot of water. Numerous rock ledges, sand-bars, and

rapids occurred between reaches of deeper water well adapted to navigation.

The project for the improvement between Brook Neal and Randolph Station, 31 miles below, on the Richmond and Danville Railroad, was adopted in 1879, the object being to secure a navigable channel not less than 35 feet wide and 2 feet deep at low water through the various obstructions.

The amount expended upon this portion of the river to June 30, 1888, was \$32,112.

About 29½ miles of the river were opened for navigation by small steamers. During the year ending June 30, 1889, there has been expended \$2,465.82, making a total to June 30, 1889, of \$35,034.18. The expenditure during the year was upon the improvement of the rapids at White Rock Falls, which was only partly completed.

July 1, 1888, amount available.....		\$388.00
Amount appropriated by act of August 11, 1888.....		5,000.00
		<hr/> 5,388.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$2,364.40	
July 1, 1889, outstanding liabilities.....	557.78	
	<hr/>	2,922.18
July 1, 1889, balance available.....		<hr/> 2,465.82

Amount (estimated) required for completion of existing project.....	31,200.00
Amount that can be profitably expended in fiscal year ending June 30, 1891	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 12.)

(b) *Between Pig River and Brook Neal.*—The project for the improvement between Pig River and Brook Neal was adopted in 1882, the object being to secure a navigable channel for bateaux not less than 14 feet wide and from 1½ to 2 feet deep at low water, with a slope of water-surface at rapids not greater than 10 feet per mile.

The amount expended upon this portion of the river to June 30, 1888, was \$6,573.04. This expenditure resulted in opening a channel from the Virginia Midland Railroad Bridge to a distance of 18½ miles above. During the year ending June 3, 1889, there has been expended \$426.96, making a total expended to June 30, 1889, of \$7,000. The expenditure during the year made the channel available for about 18½ miles above the Virginia Midland Railroad Bridge.

July 1, 1888, amount available.....	\$426.96
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	426.96

(See Appendix L 12.)

13. *Dan River, Virginia and North Carolina.*—The navigation in the Dan River, between Madison, N. C., and Danville, Va., prior to the improvement, was obstructed by numerous bowlders and rock ledges and sand and gravel bars and rapids.

Between these obstructions were pools or reaches of navigable water.

The original project for this improvement was adopted in 1880, the object being to afford a channel for navigation not less than 35 feet wide and not less than 1½ feet deep in pools, and 2 feet deep in the rapids at extreme low water from the head of the canal at Danville, Va., to Madison, N. C., a distance of 49.13 miles. It was believed that these depths would give for six months in the year a channel of not less than 3 feet depth through the various obstructions.

The project was afterward modified to a channel of not less than 16 feet wide and 2 feet deep in the rapids at extreme low water, which were the dimensions excavated.

The amount expended upon the improvement to June 30, 1888, was \$50,088.81.

This has secured a channel of nearly the dimensions required, from Danville to Madison, the proposed head of navigation; further work is necessary for its completion. The channel was available for rafting lumber, and for bateau navigation, except at extreme low water, though the current was rapid at several shoals which it was intended to remedy by the construction of spur-dams.

During the year ending June 30, 1889, \$411.19 has been expended, which has completed the spur-dams at Slink's Shoal, reducing the velocity of current at that point.

The funds being exhausted, and Congress having made no appropriation for the following year, the plant was sold at auction in August, 1888.

The total amount expended to June 30, 1889, is \$50.500.

July 1, 1888, amount available	\$411. 19
July 1, 1889, amount expended during fiscal year exclusive of liabilities outstanding July 1, 1888	411. 19

{ Amount (estimated) required for completion of existing project.....	7,000
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 13.)

14. *Removing sunken vessels or craft obstructing or endangering navigation.*—The *Amicus*, a wooden barge, was sunk April 8, 1888, at Skidmore's Bar, in the Pamunky River, 48 miles above West Point, Va., and was abandoned by her owners.

She was an obstruction to navigation and prevented dredging which was proposed in the project for the improvement of the Pamunky River during the year 1889.

The usual notice of thirty days to persons interested was published, and proposals were opened May 6, 1889.

The bid of \$800 by Messrs. James H. and Charles H. Denmead, of West Point, Va., was the lowest received, and a contract was made with them, and was approved June 5, 1889. The work of removal commenced June 11, and was in progress at the close of the fiscal year.

(See Appendix L 14.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examinations of the following localities were made by the local engineer in charge, Mr. S. T. Abert, United States agent, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers concurring in the conclusions reached in these instances, has given no instructions to make further survey with the view to their improvement.

1. *Hull's Creek, Virginia.*—(See Appendix L 15.)
2. *Hunting Creek at its mouth, Virginia.*—(See Appendix L 16.)
3. *Channel crossing the Potomac River, from Alexandria, Virginia, to the Maryland side.*—(See Appendix L 17.)

Preliminary examinations of the following localities were made by the

local engineer, Mr. S. T. Abert, United States agent, and reported by him as worthy of improvement:

1. *Quantico Creek, Virginia*.—(See Appendix L 18.)
2. *Ware River, Virginia*.—(See Appendix L 19.)
3. *Machodac River, Virginia*.—(See Appendix L 20.)

The Division Engineer, Col. William P. Craighill, did not concur in the opinion of Mr. Abert. I am not satisfied that these localities are worthy of improvement, and for this reason surveys have not been ordered.

It appearing from the report of the preliminary examinations made by the local engineer that the following localities are worthy of improvement, and the public necessity therefor being apparent from the facts and reasons reported, which are concurred in by the Chief of Engineers, Mr. S. T. Abert, United States agent, was charged with their survey, the results of which will be submitted when received:

1. *Ocoquan Creek, Virginia*.
3. *Acquia Creek, Virginia*.
3. *Chickahominy Creek [River], Virginia*.

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS OF NORTH CAROLINA AND SOUTH CAROLINA.

Officer in charge, Capt. W. H. Bixby, Corps of Engineers, having under his immediate orders, until August 28, 1888, First Lieut. H. Taylor, Corps of Engineers. Division Engineer, Col. W. P. Craighill, Corps of Engineers.

1. *Roanoke River, North Carolina and Virginia*.—When placed under governmental improvement in 1872, this stream possessed a 10-foot depth of channel from its mouth 61 miles up to Hamilton, thence a 5-foot depth 68 miles further to Weldon (about eight months per year), this channel depth being reduced during the low-water season to 10 feet to Hamilton and 2 feet to Weldon. Over the whole 129 miles the river was more or less obstructed by snags, fallen trees, rocky bars, and by war obstructions.

The original projects of 1872 contemplated the removal of the war blockades, a few rocky bars, and all sunken logs, snags, floating and other obstructions, and the contraction of the channel-way by jetties, so as to assure during the entire year an unobstructed 10-foot navigation up to Hamilton, and 5-foot navigation up to Weldon. The total final cost of this work below Weldon was estimated in 1872 at \$269,000 for a steam-boat channel of 5 feet depth at low water.

Up to June 30, 1888, a total of \$71,152.69 (including outstanding liabilities) had been spent upon this improvement, giving a moderately well-cleared channel over the entire length of the river, allowing a 10-foot navigation 61 miles to Hamilton and a 2-foot navigation 68 miles further to Weldon all the year; and also a fairly well-cleared 5-foot navigation all the way to Weldon during eight months of the year.

During the fiscal year ending June 30, 1889, an additional \$11,021.09, including outstanding liabilities, was spent mainly above Hamilton, in removing the worst leaning trees and other bank obstructions from the entire river and clearing a good channel of 100 feet width and 7 feet depth from Hamilton, 36 miles upward to Little Rocky Bar, and to 5 feet depth 22 miles further to Halifax, and of natural depth 10 miles further to Weldon. Such money as is now on hand will be used up before new appropriations can become available.

After the improvement is finished its proper maintenance may cost from \$2,000 to \$6,000 per year.

The aggregate amount appropriated for these projects up to June 30, 1889, is \$113,000.

July 1, 1888, amount available	\$2,564.28
Amount appropriated by act of August 11, 1888	40,000.00
	<hr/> 42,564.28
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$10,106.64
July 1, 1889, outstanding liabilities	914.45
	<hr/> 11,021.09
July 1, 1889, balance available	31,543.19
<hr/>	
{ Amount (estimated) required for completion of existing project	156,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	45,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix M 1.)	

2. *Pamlico and Tar rivers, North Carolina.*—The Pamlico and Tar rivers are different portions of a single stream, the upper portion being called the Tar.

When placed under improvement in 1876, the Pamlico River had an available depth of only 3 feet at low water in its upper portion, near Washington. The Tar River had during eight months of the year an available depth of from 2 to 3 feet for 49 miles up to Tarborough, its practical limit of navigation. The channel of the combined stream was almost completely obstructed by two war blockades, and by floating and sunken stumps and logs, and by overhanging trees.

The original project of 1876 (for the Pamlico) and of 1879 (for the Tar), as since slightly modified and continued to date, proposed to secure a clear channel 9 feet deep at low water up to Washington; thence a channel 60 feet wide and 3 feet deep at low water, 23 miles further to Greenville, and thence a channel 60 feet wide and 20 inches deep, 26 miles further to Tarborough. The final total cost of this work was estimated in 1888 at \$76,000.

Up to June 30, 1888, a total of \$57,776.33 had been spent upon this improvement in securing a good channel at least 9 feet deep at low water and at least 108 feet wide from Pamlico Sound, 37 miles, up to Washington; thence a fair channel 60 feet wide and 3 feet deep all the year, 23 miles, to Greenville, and thence a similar channel for eight months of the year, 26 miles, to Tarborough.

During the fiscal year ending June 30, 1889, an additional \$6,832.20, including outstanding liabilities, was spent in removing the worst obstructions from 23 miles of river above Tarborough and in maintaining the existing channel below Tarborough. Work was stopped during a part of the year for want of funds. Such money as now remains on hand will be expended before new appropriations can become available.

After the improvement is finished, its proper maintenance may cost from \$1,000 to \$3,000 per year.

The aggregate amount appropriated for these projects up to June 30, 1889, is \$68,000.

July 1, 1888, amount available	\$223.67
Amount appropriated by act of August 11, 1888	10,000.00
	<hr/> 10,223.67
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$6,005.24
July 1, 1889, outstanding liabilities	826.96
	<hr/> 6,832.20
July 1, 1889, balance available	3,391.47

Amount (estimated) required for completion of existing project	\$8,000.00
Amount (estimated) required for completion of new project	16,200.00
	<hr/>
Amount that can be profitably expended in fiscal year ending June 30, 1891	\$24,200.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	10,000.00
(See Appendix M 2.)	

3. *Contentnia Creek, North Carolina.*—When placed under improvement in 1881 this stream had a depth of about 3 feet, during nine months of the year, from its mouth in the Neuse upward about 63 miles to Stantonsburgh, its practical limit of navigation; but its channel was completely blocked at all stages of water by sunken logs and stumps, and by floating obstructions.

The original project of 1881, as continued to date, proposed to secure a safe and unobstructed 3-foot navigation over this distance during the high-water season of about nine months. The final total cost of this work was estimated in 1888 at \$77,500.

Up to June 30, 1888, a total of \$39,548.68 had been spent in securing a moderately well-cleared 3-foot navigation over the 31 miles from its mouth up to Snow Hill, and a roughly-cleared 3-foot navigation over 32 miles further to Stantonsburgh, during the high-water season.

During the fiscal year ending June 30, 1889, an additional \$3,829.34 was spent in removing the worst remaining obstructions in the river (mainly above Snow Hill), opening a passable channel to Stantonsburgh during nine months of the year for 3-foot draught boats. Work in the field was stopped in January, 1889, because the available funds were no longer sufficient for advantageous use.

After the improvement is finished its proper maintenance may cost from \$1,000 to \$3,000 per year.

The aggregate amounts appropriated for these projects up to June 30, 1889, is \$45,000.

July 1, 1888, amount available	\$451.32
Amount appropriated by act of August 11, 1888	5,000.00
	<hr/>
	5,451.32

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$3,746.84
July 1, 1889, outstanding liabilities	82.50
	<hr/>
	3,829.34

July 1, 1889, balance available	1,621.98
	<hr/>

Amount (estimated) required for completion of existing project	32,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M 3.)

4. *Trent River, North Carolina.*—When placed under improvement in 1879, this river had a 6-foot to 8-foot roughly-cleared navigation from its mouth, at New Berne, up 21 miles to Pollocksville, and a light-draught navigation 9 miles further to Quaker Bridge. Above Pollocksville the bars, snags, and trees prevented all navigation, except occasionally by small flat-boats during high freshets.

The original projects of 1879 to 1880, as continued to date, assumed that 6 to 8 feet of water could be carried at all stages from its mouth 21 miles to Pollocksville, and proposed to secure a thoroughly cleared 3 foot navigation, with at least 50 feet channel width at all stages of

water, from Pollocksville 22 miles up to Trenton, the practical limit of steam-boat navigation, using the balance of the funds to improve the channel from its mouth, 30 miles upwards to Pollocksville and Quaker Bridge. The final total cost of this work was estimated in 1888 at \$59,000.

Up to June 30, 1888, a total of \$42,704.98 had been spent in all upon this improvement, in securing a moderately well-cleared 6-foot to 8-foot navigation at all stages (8 to 9 feet at ordinary stages) from New Berne 30 miles up to Quaker Bridge; and thence a thoroughly-cleared 3-foot navigation at least 50 feet wide at all stages 13 miles further to Trenton and an excellent turning-basin at Trenton.

During the fiscal year ending June 30, 1889, an additional \$6,867.40, including outstanding liabilities, was spent in dredging and blasting a channel-way, 100 feet width, 8 feet depth at low water, through Foy's Flats, thus practically adding 3 feet to the draught available to steamers and schooners going to Pollocksville. Work was stopped during a portion of the year for want of funds. Such money as now remains on hand will be expended before new appropriations can become available.

After the improvement is finished its proper maintenance may cost from \$1,000 to \$2,000 per year.

The aggregate amount appropriated for these projects up to June 30, 1889, is \$50,500.

July 1, 1888, amount available	\$2,795.02
Amount appropriated by act of August 11, 1888	5,000.00
	<hr/> 7,795.02
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$6,795.23
July 1, 1889, outstanding liabilities	72.17
	<hr/> 6,867.40
July 1, 1889, balance available	927.62
	<hr/>
{ Amount (estimated) required for completion of existing project	8,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	8,500.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M 4.)

5. *Neuse River, North Carolina.*—When placed under improvement in 1878, this river had during nine months of the year a 9-foot depth of channel from its mouth 49 miles up to New Berne, thence a 4-foot depth 50 miles further to Kinston, thence a 3-foot depth 46 miles further to Goldsborough, and thence a 2-foot depth 62 miles further to Smithfield, this channel depth being reduced during the low-water season to 8 feet at New Berne, 2 feet at Kinston, and 1 foot at Smithfield. Over the whole 198 miles the river was so blocked by war and other obstructions that navigation was impracticable.

The original projects of 1871 for below Goldsborough, and of 1879 for above Goldsborough, contemplated the removal of the war blockades and natural obstructions and the excavation of a few cut-offs, so as to get 4.5 feet at low water all the year to Goldsborough, and 3 feet during nine months to Smithfield. The projects of 1878, 1880, and 1883, as continued to date, propose to remove all sunken logs, snags, floating, and other obstructions, and to contract the channel-way by jetties, so as to assure during the entire year an unobstructed 8 foot navigation 40 miles up to New Berne, and a similar 4-foot navigation 50 miles further to Kinston, and during nine months of the year a 3-foot navi-

gation 108 miles further to Smithfield. The final total cost of this work was estimated in 1888 at \$374,000.

Up to June 30, 1888, a total of \$226,017.60 had been spent in all upon this improvement, giving a moderately well-cleared channel over the entire length of the river, allowing an 8-foot navigation 40 miles to New Berne, and a 3-foot navigation 50 miles further to Kinston all the year; also a fair 3-foot navigation 46 miles further to Goldsborough during nine months per year, and still 62 miles further to Smithfield six months per year.

During the fiscal year ending June 30, 1889, an additional \$7,250.17, including outstanding liabilities, was spent in contracting by jetties about 2 miles of the river between Kinston and New Berne, and in removing dangerous obstructions from 1 mile of specially bad river above Kinston, thereby much improving the navigation at these points. Other work was left to await the low-water season of the present year, during which all the present available funds will be expended.

After the improvement is finished, its proper maintenance may cost from \$2,000 to \$6,000 per year.

The aggregate amount appropriated for these projects up to June 30, 1889, is \$247,500.

July 1, 1888, amount available, including amounts covered by existing contracts.....	\$6,482.40
Amount appropriated by act of August 11, 1888.....	15,000.00
	<hr/> 21,482.40
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$6,117.09
July 1, 1889, outstanding liabilities.....	1,133.08
July 1, 1889, amount covered by existing contracts.....	715.55
	<hr/> 7,965.72
July 1, 1889, balance available.....	<hr/> 13,516.68

{ Amount (estimated) required for completion of existing project.....	126,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	30,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M 5.)

6. *Inland water-way between New Berne and Beaufort, North Carolina.*—The inland line of navigation from New Berne to Beaufort Harbor, via Clubfoot, Harlowe, and Newport rivers, was established by the State of North Carolina about 1826, and was used thereafter by small craft until about 1856, when its locks broke down and the route was abandoned. This line, about 42 miles in total length, extends from New Berne about 23 miles down the Neuse River, 6 miles up Clubfoot River, 3.21 miles through the Clubfoot and Harlowe Canal, 3.5 miles down Harlowe River, and 6 miles through Newport River to Beaufort Harbor. About 1880 the line was re-opened by the New Berne and Beaufort Canal Company.

When placed under improvement in 1885, this route allowed the passage of small boats of 15 feet width and 3 feet draught, but the commerce was practically nothing.

The original project of 1883 reported this route as worthy of improvement, providing that Congress desired to extend the already existing lines of navigation from the Chesapeake southward, and estimated the cost of a channel 80 feet wide and 9 feet deep at \$883,580, increased by the cost of a tide-lock and the canal company's franchise.

A modified project of 1884 for the expenditure of the funds then available, as continued to date, proposed to widen and deepen Harlowe Creek so as to secure a through canal of 5 feet depth at mean low water, and of 30 feet bottom width from the mouth of Harlowe Creek upwards 3.25 miles to its head, and to use the remaining funds upon similar works upon Clubfoot River. The total final cost of this latter project (including also the continuation of the same work through the canal) was estimated in 1886 at \$92,000.

Up to June 30, 1888, a total of \$6,812.45 had been spent in all upon this improvement, on necessary surveys, in the removal of the worst logs and stumps in the existing channel, and in dredging the creek to 30 feet width and 5 feet depth at low water over a length of 873 feet, and to a width and depth through the entire creek sufficient to allow the passage of small sail-boats.

During the fiscal year ending June 30, 1889, an additional \$17,430, including outstanding liabilities, was spent in opening a channel of 30 feet width and 5 feet depth at low water through 13,000 feet length of the worst portions of Harlowe Creek, securing a far better navigation through Harlowe Creek than exists through the New Berne and Beaufort Canal, to which it leads. Further work is postponed to await action on the part of the owners of the canal as to its cession or sale.

After the proposed channel is opened its proper maintenance may cost from \$1,000 to \$3,000 per year.

The aggregate amount appropriated for these projects up to June 30, 1889, is \$35,000.

July 1, 1888, amount available, including amounts covered by existing contracts	\$13, 187. 55
Amount appropriated by act of August 11, 1888.....	15, 000. 00
	<hr/> 28, 187. 55
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$15, 365. 84
July 1, 1889, outstanding liabilities.....	2, 064. 16
July 1, 1889, amount covered by existing contracts.....	1, 244. 63
	<hr/> 18, 674. 63
July 1, 1889, balance available.....	<hr/> 9, 512. 92
{ Amount (estimated) required for completion of existing project.....	57, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix M 6.)	

7. *Harbor at Beaufort, North Carolina.*—This harbor, at the eastern terminus of the Atlantic and North Carolina Railroad, is the only harbor of any importance between Chesapeake Bay and Wilmington, N. C., a distance of over 300 miles.

When placed under improvement in 1880 it possessed a bar entrance of 15.3 feet least depth at mean low water, with an average rise and fall of tide of 8 feet. At this time, however, the northern entrance was rapidly deteriorating; its width, measured from Fort Macon Point to Shackleford Point, having increased 500 feet between the years 1864 and 1880, and 900 feet more between the years 1880 and 1881, and its bar having rapidly and proportionally shoaled. From the bar the harbor possessed a channel of 25 feet depth upwards for 3.7 miles to the Atlantic and North Carolina Railroad Wharf at Morehead City, and a branch channel of 9 feet depth for six-tenths of a mile up to Bulkhead Channel, and of 2 feet minimum depth for six-tenths of a mile further

to the wharves of Beaufort City, where coasting vessels had a good wharfage of 7 feet depth and 1,800 feet length.

The project of 1881, 1882, and 1884, as continued to date, proposed to secure this harbor by stopping further erosion of the sand-banks at Shackleford Point and Fort Macon Point, and thus stopping further deterioration of the bar entrance, and proposed to open a 5-foot channel 100 feet wide to Beaufort City. The total final cost of this work was estimated in 1887 at \$163,000.

Up to June 30, 1888, a total of \$88,869.48 had been spent in all upon this improvement, in successfully stopping the erosion of Shackleford Point and Fort Macon Point, in probably arresting the shoaling upon this bar, and in making surveys of the condition of the harbor entrance preparatory to the definite location of work. No special improvement of commerce nor depth of water was thereby expected or obtained, but the retrograde movement has been in general arrested, the old shore-lines have commenced to reform as desired, and the former good condition of the harbor is being rapidly re-established.

During the fiscal year ending June 30, 1889, an additional \$13,103.14, including outstanding liabilities, was spent in strengthening existing jetties, and building catch-sand fences at Shackleford Point, and in cutting a channel of from 30 to 50 feet width and 5 feet depth at low water through the shoal in front of Beaufort City and allowing boats of 8 feet draught to reach the city wharves. Work was stopped during a part of the year for want of funds. Such money as is now on hand will be used up before new appropriations can become available.

This improvement, once thoroughly finished, should be comparatively permanent.

The aggregate amount appropriated for these projects up to June 30, 1889, is \$125,000.

July 1, 1888, amount available.....	\$1, 130. 52
Amount appropriated by act of August 11, 1888.....	35, 000. 00
	<hr/> 36, 130. 52
July 1, 1889, amount expended during fiscal year, exclusive of	
liabilities outstanding July 1, 1888.....	\$9, 388. 51
July 1, 1889, outstanding liabilities.....	3, 714. 63
July 1, 1889, amount covered by existing contracts.....	11, 910. 68
	<hr/> 25, 013. 82
July 1, 1889, balance available.....	11, 116. 70
	<hr/>
{ Amount (estimated) required for completion of existing project.....	38, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	38, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and	
harbor acts of 1866 and 1867.	
(See Appendix M 7.)	

8. *Inland water-way between Beaufort Harbor and New River, North Carolina.*—When placed under improvement in 1886 there was a channel 18 inches deep at low water from Beaufort to the town of Swansborough, on White Oak River; thence a 3-foot depth at mid-tide 6 miles further to Bear Inlet and Creek; thence a 6-inch depth at low water 11 miles further to New River, whence boats of 5 feet draught could proceed 14 miles further to the town of Jacksonville.

The original project of 1885, as continued to date, recommended the establishment of a channel of at least 3 feet depth at low water from Beaufort to Swansborough. The total final cost of this work was estimated in 1887 at \$50,000.

Up to June 30, 1888, a total of \$6,676.51 had been spent upon this

improvement in securing a channel-way of at least 40 feet width and of 3 feet depth at low water across the worst shoal between Beaufort Harbor and Swansborough.

During the fiscal year ending June 30, 1889, an additional \$7,918.55, including outstanding liabilities, was spent in cutting a channel of 40 feet width and at least 3 feet depth at low water across the second and third worst shoals, thus allowing steam-boats of 3 feet draught to pass daily over the entire route. Work was stopped in April, 1889, for want of funds.

This improvement, once thoroughly finished, should be comparatively permanent.

The aggregate amount appropriated for these projects up to June 30, 1889, is \$15,000.

July 1, 1888, amount available, including amounts covered by existing contracts	\$3,323.49
Amount appropriated by act of August 11, 1888.....	5,000.00
	<hr/> 8,323.49
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$7,910.22
July 1, 1889, outstanding liabilities.....	8.33
	<hr/> 7,918.55
July 1, 1889, balance available.....	<hr/> 404.94
{ Amount (estimated) required for completion of existing project.....	35,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	35,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M 8.)

9. *New River, North Carolina.*—When placed under improvement in 1882, this river had very poor facilities for transporting goods to market. Its outlet to the ocean was blocked by an oyster-rock barricade, through which there existed only a long and very crooked channel of 50 feet width and 3 feet depth at low water.

The original project, as continued to date, proposed to secure a 150-foot channel, 5 feet deep at low water, from the upper river to the ocean, by dredging. The total final cost of this work was estimated in 1885 at \$40,000.

Up to June 30, 1888, a total of \$18,183.41 had been spent in all upon this improvement, in replacing the long and crooked channel by a shorter and straighter channel of at least 40 feet bottom width and 3.5 feet depth at low water. The new channel is already in daily use by the craft entering New River from the ocean, and is steadily deepening under the scour of the river and tidal currents.

During the fiscal year ending June 30, 1889, an additional \$349.08, including outstanding liabilities, was spent in office work and in vainly endeavoring to find a contractor willing to enter this river to do the amount of dredging allowed by the existing available funds.

This improvement, once thoroughly completed, should be comparatively permanent.

The aggregate amount appropriated for these projects up to June 30, 1889, is \$23,000.

July 1, 1888, amount available	\$1,816.59
Amount appropriated by act of August 11, 1888.....	3,000.00
	<hr/> 4,816.59
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1889.....	349.08
July 1, 1889, balance available.....	<hr/> 4,467.51

{ Amount (estimated) required for completion of existing project \$17, 000. 00
 Amount that can be profitably expended in fiscal year ending June 30, 1891 17, 000. 00
 Submitted in compliance with requirements of sections 2 of river and
 harbor acts of 1866 and 1867.

(See Appendix M 9.)

10. *Black River, North Carolina.*—When placed under improvement in 1886, this river had a moderately well cleared channel from its mouth (in the Cape Fear River, 14 miles above Wilmington) 22 miles upwards to Point Caswell, with 2.5 feet depth at low water and 4 feet depth at high tide, thence a roughly cleared navigation 48 miles further to near Lisbon, with 2.5 feet depth during nine months per year and with 6 feet depth during six months per year.

The original project of 1885, as continued to date, proposed to secure a fairly cleared natural channel over the entire river from its mouth up 70 miles to near Lisbon, then a 4-foot channel below Point Caswell, and then an improved channel through the Narrows. The total final cost of this work was estimated in 1885 at \$33,500.

Up to June 30, 1888, a total of \$2,267.31 had been spent upon this improvement in the removal of the worst obstructions over the entire river.

During the fiscal year ending June 30, 1889, an additional \$109.93, including outstanding liabilities, was spent in office and minor work; no field-work being advantageously possible with the small amount of funds available.

After this improvement is finished its proper maintenance may cost from \$1,000 to \$3,000 per year.

The aggregate amount appropriated for these projects up to June 30, 1889, is \$3,000.

July 1, 1888, amount available	\$732. 69
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	109. 93
July 1, 1889, balance available.....	622. 76

{ Amount (estimated) required for completion of existing project 30, 500. 00
 Amount that can be profitably expended in fiscal year ending June 30, 1891 10, 000. 00
 Submitted in compliance with requirements of sections 2 of river and
 harbor acts of 1866 and 1867.

(See Appendix M 10.)

11. *Cape Fear River, North Carolina.*—*Above Wilmington.*—When placed under improvement in 1881, the Cape Fear River above Wilmington was navigable during the nine months of the year from Wilmington 112 miles upwards to Fayetteville, but the channel for the upper 75 miles was badly obstructed by logs, snags, overhanging trees, and shoals, and for the upper 66 miles it was full of shoals on which there was not more than 12 to 14 inches of water during the low-water season. At that time the navigation was owned by private parties.

The original project of 1881-'82, as continued to date, proposed to buy out the private owners of the river for \$10,000, then to clear out its natural obstructions and to further provide a continuous channel over its upper 66 miles by dredging and by artificially contracting its waterways through at least thirty-two shoals. The total cost of this work was estimated in 1885 at \$480,000 for a 3-foot actual channel depth up to Fayetteville during eleven or twelve months of the year.

Up to June 30, 1888, a total of \$73,887.02 had been spent in all upon this improvement, giving a moderately well cleared channel over the whole length of the river, a moderately good 4-foot continuance channel

during the entire year from Wilmington, 44 miles, to Kelly's Cove; thence a similar 2-foot channel 26 miles further to Elizabethtown, and thence a similar 1-foot channel 42 miles further to Fayetteville, increased to 5-foot draught from Wilmington to Fayetteville during seven months of the year.

During the fiscal year ending June 30, 1889, an additional \$9,469.69, including outstanding liabilities, was spent in maintaining the existing channel, in completing surveys of shoals above Elizabethtown, and in quarrying rock to be used during the coming low water season at the five worst remaining shoals of the river. Work was stopped during a part of the year for want of funds.

After this improvement is completed, its proper maintenance may cost from \$1,000 to \$3,000 per year.

The aggregate amount appropriated for these projects up to June 30, 1889, is \$88,250.

July 1, 1888, amount available.....	\$2,397.38
Amount appropriated by act of August 11, 1888.....	12,000.00

14,397.38

July 1, 1889, amount expended during fiscal year, exclusive of

liabilities outstanding July 1, 1888.....	\$8,192.26
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July 1, 1889, outstanding liabilities.....	1,277.43
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9,469.69

July 1, 1889, balance available.....	4,927.69
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{ Amount (estimated) required for completion of existing project.....	188,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	60,000.00
{ Submitted in compliance with requirements of sections 2 of river and	
{ harbor acts of 1866 and 1867.	

(See Appendix M 11.)

12. *Cape Fear River, North Carolina.*—At and below Wilmington.—When placed under improvement in 1829 the Cape Fear River below Wilmington had three bar entrances with least depths as follows: About 9 feet at the Baldhead Channel, 9 feet at the Rip Channel, and 10 feet at New Inlet Channel, these bars being, respectively, 9, 6, and 2 miles below the point which was then the head of the river's delta. From the head of this delta 20 miles up to Wilmington there were several shoals with a least depth of 7.5 feet at low water.

The original projects of 1827 to 1847 proposed to improve the upper 20 miles by dredging and by jetty contraction of the channel. Two hundred and three thousand two hundred and four dollars and fifty-nine cents was spent during this time in increasing the depth upon the shoals to 9.5 feet at low water, equal to that at the bar entrances. At or about this time the shore at Fort Caswell, opposite Baldhead Point, was protected by stone jetties, under an appropriation for the preservation of fortifications.

The projects of 1852 to 1857 proposed to deepen the water at the main entrance by jetties at Baldhead Point and by jetty and dike obstructions between Zeke's Island and Smith's Island, near New Inlet, and suggested the possible future necessity of closing New Inlet. One hundred and fifty-six thousand two hundred and ninety-six dollars and twenty-six cents was spent during this time upon these works, never fully completed for want of funds.

The project of 1870 proposed a crib closure of the space (4,403 feet long) between Smith's and Zeke's islands (finished in 1873) to prevent further widening of New Inlet. The projects of 1870 to 1872 proposed the complete closure of New Inlet (begun in 1875 and finished in 1881)

in order to deepen the water at the main (Baldhead) bar entrance. The projects of 1872 to 1885, as continued to date, proposed the extension of the New Inlet Dam 2 miles further down the stream, to prevent the further erosion of Smith's Island at the Swashes. The project of 1875, as continued to date, proposed the occasional use of dredging upon the outer bar to assist the tidal currents in gradually localizing, straightening, deepening, and fixing the bar entrances to obtain first a 12-foot depth at low water and then a 14-foot depth. The projects of 1874 to 1881 for the 20 miles above New Inlet, as continued to date, proposed dredging and occasional diking wherever necessary across shoals, so as to secure first a 12-foot channel 200 feet wide and afterward a 16-foot channel 270 feet wide at low water over this whole length. The total final cost of this work under the projects of 1870 to 1885 was estimated in 1888 at \$2,120,000.

Up to June 30, 1888, a total of \$1,851,001.74 had been spent in all upon the proposed improvements of 1870 to 1882 with great success, obtaining a 14 to 14.5 feet least depth of water at the main bar entrance and completing a channel of 16 feet depth and at least 185 feet width 28 miles further to Wilmington. This depth, combined with the average rise of tide of 4.5 feet at the bar and 2.5 feet at Wilmington, is such that vessels loaded to 16 feet draught (9.5 feet more than in 1871) can readily go from Wilmington to the ocean in a single tide and any day of the year.

During the fiscal year ending June 30, 1889, an additional \$52,888.33, including outstanding liabilities, was spent in widening the existing channels to full width of about 250 feet at the four upper shoals, in maintaining the existing channel at Snow's Marsh and at the new channel across the ocean bar, in completing the dikes between the river and ocean sounds from New Inlet southward to Smith's Island, and in minor work. Recent surveys show successful results everywhere.

After the improvement is finished its proper maintenance may cost from \$5,000 to \$25,000 per year for a few years, but the improvement should be fairly permanent.

The aggregate amount appropriated for these projects of 1871 to 1885 up to June 30, 1889, is \$2,105,000.

July 1, 1868, amount available, including amounts covered by existing contracts	\$8,963.86
Amount appropriated by act of August 11, 1868	245,000.00
	<hr/> 253,963.86
July 1, 1869, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1868	\$41,963.15
July 1, 1869, outstanding liabilities	10,925.18
July 1, 1869, amount covered by existing contracts	159,233.72
	<hr/> 212,172.05
July 1, 1869, balance available	<hr/> 41,791.81
<hr/>	
{ Amount (estimated) required for completion of existing project	1,825,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	250,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M 12.)

13. *Yadkin River, North Carolina.*—The middle third of this river, the portion extending from the railroad bridge near Salisbury, 64½ miles upward, to the foot of Bean Shoal, is the only portion so far under improvement by the General Government.

When placed under improvement in 1880, this portion of the Yadkin River had its navigation completely obstructed by rock ledges, fish and mill dams, and numerous shoals, with a greatest depth of 1 foot at ordinary low water on some of its shoals and ledges.

The original project of 1879 proposed to secure a 2.5 to 3 foot steamboat navigation during the entire year over the 64½ miles above the Salisbury Railroad Bridge. The total final cost of the work necessary to give the desired depth over the entire 64½ miles, and during only mean winter stages of water (two-thirds of the year), was estimated in 1887 at \$400,000.

Up to June 30, 1888, a total of \$84,957.92 had been spent in all upon this improvement in securing a channel of 40 to 70 feet width, and from 2 to 2½ feet depth, during mean winter stages of water (eight months of the year), from the Salisbury Railroad Bridge, 28 miles upwards, to above Hartley's Mill.

During the fiscal year ending June 30, 1889, an additional \$7,149.83, including outstanding liabilities, was spent in removing rock and sand from the channel, in building rock jetties, and in surveys for remaining work. All work in the field was suspended from November to May on account of cold and high water. The funds now on hand will be used up before new appropriations can become available.

The improvement, once thoroughly completed, should be comparatively permanent.

The aggregate amount appropriated for these projects up to June 30, 1889, is \$97,000.

July 1, 1888, amount available	\$2, 042. 08
Amount appropriated by act of August 11, 1888.....	10, 000. 00
	<hr/> 12, 042. 08
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$6, 178. 79
July 1, 1889, outstanding liabilities	971. 04
	<hr/> 7, 149. 83
July 1, 1889, balance available.....	<hr/> 4, 892. 25
<hr/>	
{ Amount (estimated) required for completion of existing project.....	10, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M 13.)

14. *Harbor at Georgetown, South Carolina.*—When placed under improvement in 1880, this harbor had an excellent and well-protected anchorage of at least 1 mile in length, 150 feet width, and 15 feet depth. A bar of about 2,850 feet in length and with only 9 feet depth of water was the only obstacle to an otherwise good 13-foot navigation from Georgetown, 13 miles to the ocean.

The original project of 1881, as continued to date, proposed to secure a dredged channel of 200 feet bottom width and 12 feet low-water depth entirely through this bar. The total final cost of this work was estimated in 1888 at \$42,000. These estimates are now raised to \$44,500 for reasons stated in the report of the officer in charge.

Up to June 30, 1888, a total of \$16,834.10 had been spent in all upon this improvement, giving a through cut entirely across the bar, with 12 feet low-water depth, and with a variable width of from 80 to 100 feet.

During the last fiscal year ending June 30, 1889, an additional \$7,008.53, was used in widening the existing channel to from 110 to 140

feet. Work was stopped during a large part of the year for want of funds.

The channel, once thoroughly opened, will probably be permanent.

The aggregate amount appropriated for these projects up to June 30, 1889 is \$24,500.

July 1, 1888, amount available.....	\$165.90
Amount appropriated by act of August 11, 1888	7,500.00
	<hr/> 7,665.90
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$6,953.47
July 1, 1889, outstanding liabilities.....	55.06
	<hr/> 7,008.53
July 1, 1889, balance available.....	<hr/> 657.37

Amount (estimated) required for completion of existing project	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1891	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M 14.)

15. *Winyaw Bay, South Carolina.*—When placed under improvement in 1886 this bay had only 9 feet least depth upon its bar entrance, with a 12-foot channel the rest of the way to Georgetown.

The original project of 1885 proposed to secure a permanent bar entrance from 15 to 20 feet depth at low water. The total final cost of this work was estimated in 1885 at \$800,000 for a bar depth at 12 feet (and \$2,500,000 for a bar depth of from 15 to 20 feet) at low water.

Up to June 30, 1888, a total of \$3,751.72 had been spent upon this improvement in making necessary preparations for beginning work as soon as the available funds shall be sufficient for advantageous use.

During the fiscal year ending June 30, 1889, an additional \$3,228.54, including outstanding liabilities, was spent in preparations for work. A special examination and report upon this work (called for by the provisions of river and harbor act of August 11, 1888) were made during the year. The funds now on hand will be expended before new appropriations can become available.

The channel, once thoroughly opened, will probably retain its depth permanently.

The aggregate amount appropriated for this project up to June 30, 1889, is \$118,750.

July 1, 1888, amount available, including amounts covered by existing contracts	\$14,998.28
Amount appropriated by act of August 11, 1888.....	100,000.00
	<hr/> 114,998.28
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$3,021.92
July 1, 1889, outstanding liabilities.....	206.62
	<hr/> 3,228.54
July 1, 1889, balance available	<hr/> 111,769.74

Amount (estimated) required for completion of existing project.....	2,381,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1891.....	300,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M 15.)

16. *Removing sunken vessels or craft obstructing or endangering navigation.*—Under section 4 of act of Congress approved June 14, 1880, notice

to owners of the schooner *Laura J.*, wrecked and sunk in Bogue Sound near Beaufort, N. C., was duly published. Subsequently, in August, 1888, this wreck was removed level with the sand bottom of the sound.

(See Appendix M 16.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examination of *Swift Creek, North Carolina*, was made by the local engineer in charge, Captain Bixby, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers, concurring in the conclusion reached in this instance, has given no instructions to make further survey with the view to its improvement. (See Appendix M 17.)

At the following localities, reported by the local engineer as worthy of improvement, and this conclusion being concurred in by the Chief of Engineers, the result of the preliminary examination containing information sufficient to indicate to Congress the probable cost of the work required, no further report or survey appeared to be necessary:

1. *Ocracoke Inlet, North Carolina.*—It is proposed that the inlet and its southern inside channel be dredged to a depth of from 12 to 15 feet to form a direct ocean outlet for the commerce of Albemarle and Pamlico sounds, and also to form an inlet to a refuge from the violent storms of Hatteras. The estimated total cost of the dredging necessary is from \$100,000 for a depth of 10 feet to \$280,000 for a depth of 15 feet. If it should be found necessary to provide training or protecting dikes (which is not thought probable), they could be built for \$320,000, making a total for dredging and diking of \$600,000.—(See Appendix M 18.)

2. *Water-way between New River and Swansborough, North Carolina.*—Improvement proposed is to provide a 3 or 4 foot navigable channel at high tide from Swansborough to New River at a total cost of \$43,000.—(See Appendix M 19.)

3. *White Oak River, North Carolina.*—Considered worthy of improvement for steam-boats from the ocean upwards, about 29 miles to near Sabiston's Bridge, and thence for flats, about 21 miles further to Collin's Ford, at a total estimated cost of \$45,000.—(See Appendix M 20.)

4. *Tar River, from Tarborough to Rocky Mount, North Carolina.*—Estimated cost of improvement, \$16,200, to be applied to removing snags and other natural obstructions.—(See Appendix M 21.)

5. *Cape Fear River, North Carolina, from Wilmington to the ocean, with an estimate of the cost of its improvement, with a navigable channel twenty feet deep at mean low water.*—The improvement proposed contemplates obtaining 20 feet depth at low water in the river proper and from 18 to 20 feet depth at low water on the bar by dredging at a cost of about \$1,100,000, and if found necessary the construction of stone jetty to prevent swinging and shoaling of channel, at a cost of from \$400,000 to \$700,000. The maintenance of the 20-foot depth channel may require for annual dredging from \$18,000 to \$25,000.—(See Appendix M 22.)

6. *Pasquotank River, above the mouth of Turner's Out, North Carolina.*—Considered worthy of improvement for steam-boats between the ends of Turner's Cut (including about 1,500 feet of the Moccasin Tract), and for barges from the Moccasin Tract up about 5 miles to the

Lebanon Bridge, at a total estimated cost of \$9,000.—(See Appendix M 23.)

7. *Mackey's Creek, North Carolina.*—The improvement to consist of straightening and deepening the bar entrance from Albemarle Sound into the creek, by a short cut across a shoal. It is estimated that \$10,000 will be sufficient to obtain a good 7-foot depth of channel and \$15,000 for a 9-foot depth. The latter depth will meet all requirements for many years.—(See Appendix M 24.)

8. *Trent River, from Trenton to Upper Quaker Bridge, North Carolina.*—The improvement proposed is to clear out natural obstructions from Trenton upward for small steam-boats over the first 30 miles, and for pole-boats over the remaining 13 miles up to the Upper Quaker Bridge. Estimated cost \$13,000.—(See Appendix M 25.)

It appearing from the report of the preliminary examination made by the local engineer that *Shallotte River, North Carolina*, is worthy of improvement, and the public necessity therefor being apparent from the facts and reasons reported, which are concurred in by the Chief of Engineers, Captain Bixby was charged with its survey, the results of which will be submitted when received.

Captain Bixby was also charged with preliminary examinations of the following localities, the results of which will be submitted when received :

1. *Roanoke River, Virginia, between Clarksville and Eaton Falls.*
2. *Fishing Creek, North Carolina.*
3. *North East River, Cape Fear, North Carolina.*

IMPROVEMENT OF LUMBER RIVER, NORTH CAROLINA, OF WACCAMAW RIVER, NORTH CAROLINA AND SOUTH CAROLINA, AND OF RIVERS AND HARBORS ON THE COAST OF SOUTH CAROLINA.

Officers in charge, Capt. Frederic V. Abbot, Corps of Engineers; Division Engineer, Col. Wm. P. Craighill, Corps of Engineers.

1. *Charleston Harbor, South Carolina.*—The work of improvement in progress since 1878 comprises two jetties, composed of riprap stone resting upon a foundation-mattress of logs and brush, with a mattress heaving wherever deemed advantageous.

The two jetties spring, respectively, from Sullivan's and Morris islands, and converge on curves in such manner as to cross the bar on parallel lines at a distance of about 2,900 feet from each other. The object of the work is to establish and maintain a channel across the bar of not less than 21 feet navigable depth at mean low water, where heretofore the available low-water depth has usually not exceeded 12 feet.

The estimated cost of the original project was \$3,000,000.

This project was modified on November 10, 1888, by a special Board of Engineer officers, whose report is appended in Appendix N. The only change made in the original project being to increase the height to which the jetties are to be built. The total estimated cost is now for jetties up to low water, \$4,380,500; for jetties up to 3 feet above mean low water, \$5,334,580. This leaves \$2,548,000 to be provided for the first height, and \$3,502,000 for the second.

Work during the past fiscal year began about the middle of June, 1889, and 1,291 tons of riprap stone were deposited on the outer end of the north jetty.

No material changes in the condition of the jetties are reported.

The head of Morris Island has cut away rapidly.

On Sullivan's Island no marked changes have occurred.

The two spur-jetties built in 1884 for the protection of a portion of the shore of Mount Pleasant are in good condition.

The appropriations for this improvement aggregate at present \$1,832,500. The total expenditures have been \$1,473,568.75.

July 1, 1888, amount available.....	\$18,437.01
Amount appropriated by act of August 11, 1888	350,000.00

368,467.01

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$9,225.51
July 1, 1889, outstanding liabilities.....	2,924.53
July 1, 1889, amount covered by existing contracts.....	279,698.53

291,848.57

July 1, 1889, balance available	76,618.44
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{	Amount (estimated) required for completion of existing project.....	2,549,000.00
	Amount that can be profitably expended in fiscal year ending June 30, 1891.....	750,000.00
	Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix N 1.)

2. *Lumber River, North Carolina.*—The river is obstructed by logs, snags, stumps, overhanging trees, and in places by sand-bars. It is crossed by a number of bridges without draws. Its present commerce is small.

The project contemplates the removal of snags, logs, and overhanging trees on 98 miles below Lumberton, at an estimated cost of \$35,000.

The river and harbor act of August 11, 1888, appropriated \$5,000 for Lumber River, North Carolina. This precludes the removal of snags, etc., on that portion of the river which is in South Carolina. This portion is likewise obstructed by two low bridges without draws. It is suggested that the portion of the river in South Carolina be included in the next appropriation.

No work has been done during the fiscal year, as the exclusive right to navigate and improve Lumber River, North Carolina, now vests in an incorporated company, which has not yet made a satisfactory transfer of its rights to the United States, although this is promised free of cost.

The amount expended up to the close of the fiscal year ending June 30, 1889, was \$638.42.

Amount appropriated by act of August 11, 1888.....	\$5,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$615.56
July 1, 1889, outstanding liabilities.....	22.86

638.42

July 1, 1889, balance available.....	4,361.58
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{	Amount (estimated) required for completion of existing project.....	30,000.00
	Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
	Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix N 2.)

3. *Mingo Creek, South Carolina.*—The creek was much obstructed by snags and overhanging trees.

The project provides for removing obstructions from the mouth to William's Landing for steam-boat navigation, and above for pole-boat navigation. The estimated cost is \$17,000.

The river and harbor act of August 11, 1888, appropriated \$5,000 for this creek, which is the first appropriation.

During the fiscal year ending June 30, 1889, the creek has been cleared from its mouth upwards a distance of 17 miles. Its commerce now amounts to about \$800,000.

The total expenditures to June 30, 1889, were \$3,292.91.

Amount appropriated by act of August 11, 1888.....	\$5,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$3,292.94
July 1, 1889, outstanding liabilities.....	241.49
	<hr/>
	3,534.43
July 1, 1889, balance available.....	<hr/>
	1,465.57

{ Amount (estimated) required for completion of existing project.....	12,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	12,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix N 3.)

4. *Clark Creek, South Carolina.*—The creek forms the southern mouth of Lynche's River. Its upper end was entirely choked by drift-wood and fallen trees.

The project provides for closing the northern mouth of Lynche's River and snagging Clark Creek. The estimated cost is \$7,500.

The river and harbor act of August 11, 1888, appropriated \$2,500 for this creek, this being the first appropriation.

No work has been done on account of continuous high water.

The total expenditures, including June 30, 1889, have been \$560.91.

Amount appropriated by act of August 11, 1888.....	\$2,500.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$560.91
July 1, 1889, outstanding liabilities.....	6.67
	<hr/>
	567.58
July 1, 1889, balance available.....	<hr/>
	1,932.42

{ Amount (estimated) required for completion of existing project.....	5,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	5,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix N 4.)

5. *Ashley River, South Carolina.*—Ashley River is about 40 miles in length and runs in a generally southeasterly direction. At its mouth the city of Charleston occupies the left bank.

The plan of improvement comprised (1) the removal of a shoal at a place named Accabee, about 8 miles above the city of Charleston, where, according to a survey made in 1873, there was then only 9 feet of water at low tide; and (2) the removal of a shoal just below the Wando Phosphate Works, where only 6 feet of water was found at low tide. It was proposed to increase the draught of water over these shoals by dredging to a depth of from 10 to 11 feet at mean low tide, at an estimated cost of \$5,000.

Of four appropriations made for this work, the first three, aggregating \$4,500, were expended in improving the river at the places indicated, obtaining low-water depths of from 10 to 11 feet on widths of from 100 to over 200 feet. This satisfactory condition of the river has continued during the past fiscal year, for which reason the last appropriation of \$1,000 made by act approved August 5, 1886, was held in reserve until it should appear expedient or necessary to expend it.

It is reported that the value of its commerce has increased by \$325,000 and the tonnage by 20,000 tons.

The total amount expended to June 30, 1889, was \$4,494.91.

July 1, 1888, amount available.....	\$1, 005. 09
July 1, 1889, balance available.....	1, 005. 09

(See Appendix N 5.)

6. *Edisto River, South Carolina*.—The Edisto River is formed by the junction of the North and South Forks, which unite in the southern part of Orangeburgh County. The South Fork, commonly known as the South Edisto, is the main river.

The obstructions to navigation consist of numerous bends, logs, snags, overhanging trees, and piles; also of shoals, generally of sand, but in some places of hard clay.

The plan of improvement was modified in September, 1888, and now contemplates the establishment of a channel available at all seasons of the year for rafts and flat-boats from the sea, 260 miles, to Guignard's Landing. The plan embraces shutting off lateral arms of the river, removing shoals, snags, logs, piles, and other obstructions. The cost of the project is estimated at \$33,385.

Four appropriations made by Congress aggregate \$21,000.

The work heretofore done comprises the removal of a large number of snags, logs, overhanging trees, and piles in the reaches within 180 miles of the mouth of the river; the improvement of several snags; the closing of incipient cut-offs and outlets, and trimming the banks. They materially benefited navigation by shortening the time and reducing the expense of trips.

Work was resumed under the last appropriation of \$5,000 in May, 1889, and considerable work was done.

The total expenditures up to June 30, 1889, were \$16,617.96.

Amount July 1, 1888, amount available.....	\$145. 15
Amount appropriated by act of August 11, 1888.....	5, 000. 00
	<hr/> 5, 145. 15
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$763. 11
July 1, 1889, outstanding liabilities.....	1, 672. 58
	<hr/> 2, 435. 69
July 1, 1889, balance available.....	2, 709. 46

{ Amount (estimated) required for completion of existing project.....	12, 385. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	12, 300. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix N 6.)

7. *Salkiehatchie River, South Carolina*.—The Salkiehatchie River rises in Aiken County, South Carolina, and flows into the Atlantic Ocean. The lower part of the river is known as the Combahee. Above a point named Hickory Hill, the river was obstructed at numerous places by piles, logs, trees, and sand-bars.

The project of improvement contemplates the removal of these obstructions for the purpose of establishing a continuous channel suitable for flat-boats and rafts from a point 5 miles above Toby's Bluff down to Hickory Hill. The cost of the project was estimated at \$18,000.

Four appropriations, aggregating \$13,000, have been made by Congress.

The work done comprises thoroughly clearing the lowest 12-mile reach of the Salkiehatchie between Hickory Hill and the Charleston and Savannah Railroad Bridge and improving the reaches from that bridge to

Broxton's Bridge by removing from the channel over 12,200 snags, stumps, logs, trees, etc., closing over 138 outlets, cutting off numerous projecting points. A substantial improvement of the river is reported.

The total expenditures to June 30, 1889, was \$11,102.49.

July 1, 1888, amount available	\$337.34
Amount appropriated by act of August 11, 1888	3,000.00
	<hr/> 3,337.34
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$1,439.83
July 1, 1889, outstanding liabilities	425.03
	<hr/> 1,864.86
July 1, 1889, balance available	1,472.48
	<hr/>
{ Amount (estimated) required for completion of existing project	5,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	5,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix N 7.)

8. *Little Pee Dee River, South Carolina.*—The river was much obstructed by snags and overhanging trees, and in places it was subdivided into several branches.

The project provides for removing obstructions and closing unnecessary branches. Steam-boat navigation is provided for to the Lumber River, and pole-boat navigation above to Little Rock. The estimated cost is \$50,000.

During the past fiscal year snags were removed from the river from its mouth to a point $46\frac{1}{2}$ miles above. Its commerce amounts to about \$100,000.

The first appropriation for the river, \$5,000, was made by act of Congress of August 11, 1888.

The total expenditures to June 30, 1889, were \$3,159.88.

Amount appropriated by act of August 11, 1888	\$5,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$3,159.88
July 1, 1889, outstanding liabilities	295.47
	<hr/> 3,455.15
July 1, 1889, balance available	1,544.85

{ Amount (estimated) required for completion of existing project	45,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix N 8.)

9. *Great Pee Dee River, South Carolina.*—In charge of Capt. W. H. Bixby, Corps of Engineers, until August 25, 1888. When placed under improvement in 1880 this river was dangerously obstructed by snags and logs. Otherwise it was easily reached at a point 37 miles above its mouth by 9-foot draught boats coming from the ocean through the Waccamaw River and Bull Creek; thence it is navigable for same boats 24 miles further to Smith's Mills, and thence for 3.5-foot draught boats at low water 54 miles further from Smith's Mills to Little Bluff, or at high water 110 miles further, from Smith's Mills to Cheraw, the present head of steam navigation, 171 miles above Georgetown.

The project provides for a thoroughly cleared 9-foot navigation to Smith's Mills, and a 3.5-foot navigation to Cheraw at all stages of water. The estimated cost is \$117,000. The total amount appropriated therefor up to June 30, 1889, is \$67,000.

At ordinary stages of water there is a well-cleared 9-foot channel for 61 miles to Smith's Mills, and a fairly-cleared 3½-foot channel at low water 50 miles further, or at high water 110 miles further to Cheraw.

During the fiscal year ending June 30, 1889, but little work has been done on account of high water.

The total expenditures to June 30, 1889, were \$12,933.05.

July 1, 1888, amount available	\$968. 31
Received sale property to Cape Fear River, North Carolina.....	83. 50
Amount appropriated by act of August 11, 1888	20, 000. 00
	<hr/>
	21, 051. 81
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$8, 118. 76
July 1, 1889, outstanding liabilities	694. 14
	<hr/>
	8, 812. 90
July 1, 1889, balance available.....	<hr/>
	12, 238. 91
{ Amount (estimated) required for completion of existing project.....	50, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	25, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix N 9.)	

10. *Santee River, South Carolina.*—In charge of Capt. W. H. Bixby, Corps of Engineers, until August 21, 1888. This river was obstructed at all stages of water by sunken logs, snags, and floating timber. Its bar entrance was narrow, crooked, and shifting, with only about 4 feet depth of water at low tide, and so situated as to be difficult and expensive to improve.

The original project of 1880 proposed to provide the river with a good outlet through Mosquito Creek to Winyaw Bay, by deepening and straightening this creek to 50 feet width and 7 feet depth; and to secure a safe and unobstructed 7-foot navigation in the river itself from its mouth 154 miles upward to Wright's Bluff, and thence a similar 5-foot navigation 30 miles further to its head in the Congaree and Wateree rivers.

The total final cost of this work was estimated, in 1886, at \$346,500, of which \$271,300 for Mosquito Creek, and \$75,200 for the Santee River proper.

The Engineer officer in charge recommends a change of project as follows:

That the originally projected canal be completed to about its present width and depth; that a new cut be made between Estherville and Minim Creek, for the use of steam-boats, on the ground that to make this cut would be less costly than to widen and deepen the present canal for steam-boats. Also that a portion of each appropriation be devoted to snagging. To carry out these recommendations requires a change in the wording of the law.

The amount appropriated for this improvement up to June 30, 1889, is \$99,750.

During the past fiscal year a contract was entered into for dredging in Mosquito Creek, and work under this contract was in progress at the end of the fiscal year. Some work was done on a second drainage ditch, designed to prevent the entrance of ocean water into the canal.

Up to June 30, 1889, \$72,522.28 has been spent upon this improvement in opening a passage at least 30 feet wide and 5 feet deep at high water from Mosquito Creek to Winyaw Bay, in making necessary surveys of the whole improvement, and in building a draw-bridge over

the creek, in accordance with the provision of the cession of right of way for the canal. The effects of this work upon the rice interests of the neighborhood have been and will be beneficial rather than detrimental.

July 1, 1888, amount available.....	\$5,240.00
Received sale property to harbor at Beaufort, N. C.....	36.90
Amount appropriated by act of August 11, 1888.....	24,000.00

29,276.90

July 1, 1889, amount expended during fiscal year exclusive of liabilities outstanding July 1, 1888.....	\$2,001.04
July 1, 1889, outstanding liabilities.....	912.83
July 1, 1889, amount covered by existing contracts.....	19,525.40

22,439.27

July 1, 1889, balance available.....	6,837.63
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{ Amount (estimated) required for completion of existing project.....	246,750.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	75,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix N 10.)

11. *Wateree River, South Carolina.*—In charge of Capt. W. H. Bixby, Corps of Engineers, until August 21, 1888. When placed under improvement in 1882, this river had a low-water depth of from 3 to 4 feet from its mouth in the Santee, upward 68 miles to Camden, its practicable limit of steam navigation. From its mouth upward 14 miles the river was completely blocked at all stages of water by sunken logs and stumps and by floating obstructions, and at moderate stages by the bridges of the South Carolina and Wilmington, Columbia and Augusta Railroads (without draws); thence 54 miles to Camden navigation was possible, but dangerous, except during high water.

The original project proposed to secure a safe and unobstructed 4-foot navigation over this entire distance at all stages of water. The estimated cost is \$60,000. The total amount appropriated therefor up to June 30, 1889, is \$47,500.

No work has been done under the appropriation of August 11, 1888; but the railroads have been required to put in draws, and this work is well advanced.

Up to June 30, 1889, a total of \$35,338.79 has been spent upon this improvement, giving a thoroughly cleared 4-foot navigation at all stages of water, from the mouth of the river 11 miles upward, and thence a fairly well cleared 4-foot navigation over the rest of the river, 57 miles to Camden.

July 1, 1888, amount available.....	\$839.02
Received sale property to Cape Fear River, North Carolina.....	16.84
Amount appropriated by act of August 11, 1888.....	12,000.00

12,855.86

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$677.81
July 1, 1889, outstanding liabilities.....	13.72

691.53

July 1, 1889, balance available.....	12,164.33
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{ Amount (estimated) required for completion of existing project.....	12,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	12,500.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix N 11.)

12. *Congaree River, South Carolina.*—In charge of Capt. W. H. Bixby, Corps of Engineers, until August 21, 1888. When placed under improvement in 1886, this river had a low-water depth of from 3 to 4 feet from its mouth 48 miles upward to the railroad bridge at Columbia, and thence a 1-foot low-water depth 2 miles further to its head, the navigation of the lower 47 miles from the mouth upward to Granby being blocked at all stages of water by the South Carolina Railroad Bridge, (without a draw), and by sunken logs, snags, overhanging trees, and the navigation of the upper 3 miles above Granby being prevented by a swift current and numerous rock ledges and bowlders.

The project proposes to secure a cleared channel 4 feet deep at all stages below Granby, and a cleared channel 100 feet wide through the shoals above. The estimate was \$54,500.

No work has been done with the amount of \$7,500 appropriated August 11, 1888. The South Carolina Railroad has been required to put a draw in their bridge, and this work is well advanced.

Up to June 30, 1889, a total of \$7,438.38 has been spent on this improvement, giving a fairly well cleared navigation of 70 feet width and 4 feet depth at low water over the entire river below Granby.

July 1, 1888, amount available.....	\$571. 14
Received sale property to Roanoke River, North Carolina	4. 50
Amount appropriated by act of August 11, 1888.....	7, 500. 00
	<hr/> 8, 075. 64

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$509. 52
July 1, 1889, outstanding liabilities	1. 77
	<hr/> 511. 29

July 1, 1889, balance available	<hr/> 7, 564. 35
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{ Amount (estimated) required for completion of existing project.....	39, 500. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix N 12.)

13. *Wappoo Cut, South Carolina.*—Wappoo Cut is a narrow, crooked, tidal stream, separating James Island from the mainland, and connecting Stono and Ashley rivers.

The original project of improvement contemplated the establishment of a straighter channel, 6 feet deep and 90 feet wide at low water, at an estimated cost of \$34,000. In its unimproved condition only 2 to 4 feet could be carried over the principal shoals at mean low water.

The project was revised in 1883, and now comprises securing a channel 60 feet wide and 6 feet deep at low water, training walls at the Stono River entrance, revetting the banks of Elliott's Cut with stone, making another cut through the marsh, constructing three more closing dams, and dredging Ashley River bar. The total estimated cost, including work already done, is \$88,000.

Five appropriations, aggregating \$33,000, have been made for this work.

There is now a continuous 6-foot channel through from Ashley to Stono River at low water. This is narrow in some places.

Part of the southern bank of Elliott's Cut has been revetted with stone, and some trees and stumps have been removed during the past fiscal year.

The total amount expended to June 30, 1889, is \$31,350.

July 1, 1888, amount available.....	\$203.58
Amount appropriated by act of August 11, 1888.....	5,000.00
	<hr/> 5,203.58
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	3,553.58
July 1, 1889, balance available	<hr/> 1,650.00
{ Amount (estimated) required for completion of existing project.....	55,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	35,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix N 13.)	

14. *Waccamaw River, North Carolina and South Carolina.*—In charge of Capt. W. H. Bixby, Corps of Engineers, until August 25, 1888. When placed under improvement, in 1880, this river was navigable for 12-foot draught boats at all stages of water from Georgetown, 26 miles, to Bull Creek, and at high water 6 miles further to Buck's Lower Mills; thence for 7-foot draught boats at high water 31 miles further to Conwayborough; thence it possessed an obstructed channel for 3-foot draught boats at ordinary winter water, 109 miles, to Reeves' Ferry, the present head of steam navigation; thence an obstructed channel with 3 feet depth at high water for 42 miles to Lake Waccamaw. The commerce of this river is estimated to have been about \$400,000 per year.

The project provides for a channel 12 feet deep at all stages of water, with 80 feet bottom width, from the mouth of the river to Conwayborough, thence a clear channel to Lake Waccamaw. The estimated cost is \$138,400.

During the fiscal year ending June 30, 1889, about 2,000 obstructions were removed from the channel, and 5,000 obstructions overhanging the banks were cut.

Up to June 30, 1889, \$58,584.18 has been spent, giving a thoroughly cleared channel, with 100 feet least width, and 8.8 feet least depth at high water (7 feet at low water) as far as Conway, and with 45 feet width and 3 feet depth 72 miles above Conway.

July 1, 1888, amount available.....	\$786.46
Received sale property to Nense River, North Carolina.....	6.00
Amount appropriated by act of August 11, 1888.....	15,000.00
	<hr/> 15,793.06
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$8,970.64
July 1, 1889, outstanding liabilities.....	1,386.00
	<hr/> 10,356.64
July 1, 1889, balance available.....	<hr/> 5,436.42
{ Amount (estimated) required for completion of existing project.....	73,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	25,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix N 14.)	

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examinations of the following localities were made by the local engineer in charge, Captain Abbot, and reported by him as not worthy of improvement, with facts and reasons for such opin-

ion: The Chief of Engineers, concurring in the conclusions reached in these instances, has given no instructions to make further survey with the view to their improvement:

1. *Broad and Saluda River, above Columbia, South Carolina.*—(See Appendix N 15.)

2. *Connect North Edisto and South Edisto Rivers by St. Pierre River and South Creek, South Carolina.*—(See Appendix N 16.)

3. *Combahee River, South Carolina: Examine whether the breaking of Bull River into Combahee River, near the head of Bull River, will injure the navigation of Combahee River, and report a plan for obstructing said breaks, and the cost thereof.*—(See Appendix N 17.)

The required preliminary examination of *Socastee Creek, South Carolina, from its entrance into Waccamaw River to the bridge at Socastee*, was made by the local engineer in charge, and he considers it worthy of improvement to the extent of \$10,000, to be expended in making a cut about 40 feet wide and 4 feet deep at low water through the Cypress Swamp from the bridge at Socastee for about three-fourths of a mile, also in clearing out obstructions, widening and deepening in places, just below the proposed cut.

This opinion being concurred in by the Chief of Engineers, and the result of the preliminary examination containing information sufficient to indicate to Congress the probable cost of the work required, no further report or survey appeared to be necessary.

About \$1,000 would probably be needed annually for maintenance. (See Appendix N 18.)

Captain Abbot also made a preliminary examination, provided for by the act, of *Ashepoo River, South Carolina, from the Charleston and Savannah Railroad Bridge, 6 miles down the river, with view to removing obstructions and shoals caused by sunken vessels*, and states that he does not consider the river worthy of an expensive improvement. Having carefully considered the report made by the local engineer, in my opinion this locality is not at present worthy of improvement, and no instructions were therefore given for the survey proposed. (See Appendix N 19.)

It appearing from the report of the preliminary examination made by the local engineer that the following localities are worthy of improvement, and the public necessity therefor being apparent from the facts and reasons reported, which are concurred in by the Chief of Engineers, Captain Abbot was charged with their survey, the results of which will be submitted when received.

1. *Beaufort River, South Carolina, from a point three miles south of the town of Beaufort through to Coosaw River, with view to its improvement, especially at Brick-yard.*

2. *Owendaw and Wando rivers and other waters and water-routes connecting Bull's Bay and the harbor of Charleston, South Carolina.*

IMPROVEMENT OF CERTAIN RIVERS AND HARBOES IN GEORGIA, AND OF CUMBERLAND SOUND, GEORGIA AND FLORIDA.

Officer in charge, Lieut. O. M. Carter, Corps of Engineers. Division Engineer, Col. William P. Craighill, Corps of Engineers.

1. *Savannah River and Harbor, Georgia.*—The plan according to which operations have up to the present time been carried on in the Savannah Harbor and River was adopted in 1873, and modified and enlarged in 1879 and again in 1882. It contemplated the establishment of a channel from Tybee Roads to the city of Savannah, navigable at high water

for vessels of 22 feet draught, and the widening of the river opposite the city to 600 feet, of uniform depth with the balance of the channel. The cost was originally estimated at \$182,000, and as amended and enlarged at \$1,212,000.

The cost of obtaining a channel 26 feet deep at mean high water from the city to the sea is estimated at \$2,900,000.

In 1873, prior to improvement, the channel was, in places, not more than 9 feet deep at mean low water, and the usual high-water draught of vessels was not more than 14.5 feet.

During the fiscal year just closed 92,922.45 square yards of log and brush mattresses, 8,108.5 cubic yards of stone, and 283.3 cubic yards of oyster shells have been used in the Oyster Bed training-wall. In the Fig Island training-wall 2,795.35 cubic yards of brush fascines have been used, and 622 cubic yards of stone removed.

Between the city water-works and Tybee Roads 187,671.52 cubic yards of material have been dredged. The hydrographic survey of the river has been completed. The expenditures during the year amounted to \$106,028.34.

The total amount expended to June 30, 1889, including all outstanding liabilities is \$1,170,664.55, and has resulted in securing a navigable channel from the city to the sea with a least mean low-water depth of 13 feet, a gain of 4 feet since the work was begun.

The gain in navigable depth is somewhat greater than here shown, and vessels of from 20 to 21 feet draught now go from the city to the sea on a single tide.

The estimated reduction in freight rates, due to the improvements already executed, is 25 per cent., which effects an annual saving in freights alone of more than the total sum of money expended by the United States upon the harbor within the last twenty-five years. There is no reason to believe that future expenditures for this work would yield a less valuable return.

July 1, 1888, amount available.....	\$4 0.65
Amount appropriated by act of August 11, 1888.....	180,000.00
	<hr/> 180,420.65
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$106,028.34
July 1, 1889, outstanding liabilities.....	33,056.86
July 1, 1889, amount covered by existing contracts.....	26,858.34
	<hr/> 165,943.54
July 1, 1889, balance available	14,477.11
{ Amount (estimated) required for completion of existing project.....	2,900,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891.....	500,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix O 1.)

2. *Savannah River, Georgia.*—The present project for the improvement of this river was adopted in 1880, the object being to secure a low-water steam-boat channel not less than 5 feet in depth between the cities of Augusta and Savannah, Ga.

The cost of the improvement was originally estimated at \$91,000, and in 1887, for reasons given in the Annual Report of that year, at \$176,000. Prior to the improvement navigation was much impeded by logs, snags, piles, and other obstructions. The depth at summer low water over some of the shoals did not exceed 2 or 3 feet.

A survey of the river has been begun but high water has interfered with its progress. The expenditures during the year amounted to \$4,750.62. The total amount expended to June 30, 1889, including all outstanding liabilities, is \$78,603.73, and has resulted in improving the condition of the shoals near Augusta, and in removing the most dangerous obstructions to navigation throughout the whole extent of the river, no accidents to steam-boats having occurred since these obstructions were removed.

The amount necessary to complete the improvement can not be estimated in advance of an examination, to be completed when the stage of the river will permit.

July 1, 1888, amount available.....	\$150.23
Amount appropriated by act of August 11, 1888	21,000.00
	<hr/> 21,150.23
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$4,750.62
July 1, 1889, outstanding liabilities.....	1,503.34
July 1, 1889, amount covered by existing contracts.....	2,100.00
	<hr/> 8,353.96
July 1, 1889, balance available.....	12,796.27
	<hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	50,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix O 2.)	

3 *Savannah River above Augusta, Georgia.*—The project for the improvement of this river was adopted in 1879, the object being to secure a low water pole-boat channel, 30 feet in width and 3 feet in depth, between Augusta and Trotter's Shoal, 64 miles above. The cost of the improvement, which was not based upon accurate surveys, was estimated at \$45,000.

The obstructions to navigation consisted chiefly of rock ledges running across the channel, bowlders of various sizes, and shoals of gravel, with depths at low-water stage of from 1 to 2 feet.

No work has been done upon this river since August, 1883.

The total amount expended to June 30, 1889, including all outstanding liabilities, is \$38,346.98, and has resulted in improving the medium-stage channel through a few of the rock ledges, and in removing some of the most dangerous bowlders obstructing navigation. No additional commerce has been developed upon the stream by the work done, nor have freight rates been appreciably reduced by that cause.

July 1, 1888, amount available	\$703.02
July 1, 1889, outstanding liabilities.....	50.00
	<hr/>
July 1, 1889, balance available	653.02
(See Appendix O 3.)	

4. *Romley Marsh, Georgia.*—The project for the improvement of this locality was adopted in 1880, the object being to open a cut, with a minimum bottom width of 48 feet and a mean low water depth of 7 feet, between Dead Man's Hammock Creek on the north and Wassaw Creek on the south. The cost was estimated at \$38,720.

The natural channel is extremely crooked and difficult to navigate, and at the shoalest part not more than 3.5 feet deep at mean low water. No work was done during the last fiscal year. The expenditures during the year amounted to \$4,682.77.

The total amount expended to June 30, 1889, including all outstanding liabilities, is \$46,936.22, including \$5,000, advanced by private parties, and has resulted in the completion of the work, securing a navigable channel between Wassaw and Ossabaw Sounds with a low-water depth of not less than 5 feet.

No appropriation is asked for the next fiscal year.

July 1, 1888, amount available	\$221.55
Amount appropriated by act of August 11, 1888.....	4,633.77
	<hr/> 4,855.32
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	4,682.77
	<hr/> 172.55
July 1, 1889, balance available	
(See Appendix O 4.)	

5. *Altamaha River, Georgia.*—The present project for the improvement of this river was adopted in 1880, the object being to secure a steam-boat channel 80 feet in width and 3 feet in depth at low-water stage between Darien, Ga., and the junction of the Oconee and Ocmulgee rivers. The cost of improvement was originally estimated at \$60,000, and in 1884 at \$75,000.

Prior to improvement navigation was much impeded by logs, snags, and other obstructions, the low-water depth at some points not exceeding 2 feet.

During the fiscal year just closed 157 snags and logs and 221 overhanging trees were removed.

The expenditures amounted to \$8,318.

The total amount expended to June 30, 1889, including all outstanding liabilities, is \$53,389.03, and has resulted in removing the most dangerous obstructions, no interruption to steam-boat navigation having occurred during the year.

July 1, 1888, amount available.....	\$4,133.57
Amount appropriated by act of August 11, 1888.....	10,000.00
	<hr/> 14,133.57
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$8,318.00
July 1, 1889, amount covered by existing contracts.....	100.00
	<hr/> 8,418.00
July 1, 1889, balance available.....	<hr/> 5,715.57

{ Amount that can be profitably expended in fiscal year ending June 30, 1891 20,000.00
{ Submitted in compliance with requirements of sections 2 of river and
harbor acts of 1866 and 1867.

(See Appendix O 5.)

6. *Oconee River, Georgia.*—The present project for the improvement of this river was adopted in 1878 and revised in 1880 and again in 1888, the object being to secure a low-water channel 3 feet in depth from Milledgeville to the mouth of the river. The cost of the improvement was originally estimated at \$10,500, and in 1888 at \$100,000.

Prior to improvement navigation was much impeded by sand-bars, overhanging trees, snags and sunken logs. On some shoals there were low-water depths of not more than 2 feet. During the fiscal year just closed 920 logs and snags and 817 overhanging trees were removed, 28 trees were deadened and 48 logs cut up on the bank.

The expenditures during the year amounted to \$3,500.21.

The total amount expended to June 30, 1889, including all outstanding liabilities is \$34,642.81, and has resulted in so improving the river that boats now run at a stage of water 4 feet lower than before the improvements were begun.

The amount necessary to complete the improvement can not be given in advance of a survey to be made as soon as the stage of water will permit.

July 1, 1888, amount available	\$1,728.23
Amount appropriated by act of August 11, 1888	12,500.00
	<hr/> 14,226.23
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$3,500.21
July 1, 1889, outstanding liabilities	368.83
	<hr/> 3,869.04
July 1, 1889, balance available	10,357.19
	<hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	25,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix O 6.)	

7. *Ocmulgee River, Georgia.*—The present project for the improvement of this river was adopted in 1876, and revised in 1882, and again in 1886, the object being to secure a low-water channel 60 feet in width and 4 feet in depth from Macon to the mouth of the river. The cost of improvement was originally estimated at \$56,240, and in 1886 at \$112,480.

Prior to improvement, navigation was much impeded by rock shoals, sand-bars, overhanging trees, snags, and sunken logs, the low-water depth at some places not exceeding 2 feet.

During the fiscal year just closed 886 snags and logs and 4,313 overhanging trees were removed; 186 trees were deadened and 18 logs cut up on the river bank. The expenditures during the year amounted to \$4,636.75. The total amount expended to June 30, 1889, including all outstanding liabilities, is \$67,981.70, and has resulted in removing many dangerous obstructions, boats now being able to run without accident at a stage of water some 3 feet lower than before the improvements were begun. The amount necessary to complete the improvement can not be given in advance of a survey to be made as soon as the stage of water will permit.

July 1, 1888, amount available	\$1,883.83
Amount appropriated by act of August 11, 1888	15,000.00
	<hr/> 16,883.83
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$4,636.75
July 1, 1889, outstanding liabilities	728.78
	<hr/> 5,365.53
July 1, 1889, balance available	11,518.30
	<hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	30,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix O 7.)	

8. *Brunswick Harbor, Georgia.*—The present project for the improvement of this harbor was adopted in 1880, and modified and enlarged in 1886, the object being to secure a navigable channel not less than 15 feet deep at mean low water. The mean rise and fall of tide is 6.8 feet.

The cost of the project of 1880 was estimated at \$73,187.50 and as enlarged in 1886 at \$190,000, inclusive of appropriations already made.

In 1880, prior to improvement, the channel was not more than 9 feet deep at mean low water.

During the fiscal year just closed a survey of the harbor was made, 50,976.67 cubic yards were dredged, from the channel, and 2,318.88 cubic yards of brush fascines and 369.30 cubic yards of stone placed in the training-wall.

The expenditures during the year amounted to \$12,655.57.

The amount expended to June 30, 1889, including all outstanding liabilities, is \$111,706.74, and has resulted in securing a navigable low-water channel not less than 15 feet deep.

July 1, 1888, amount available	\$36. 73
Amount appropriated by act of August 11, 1888	35, 000. 00
	<hr/> 35, 036. 73
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$12, 665. 57
July 1, 1889, liabilities outstanding	6, 577. 90
July 1, 1889, amount covered by existing contracts	15, 200. 12
	<hr/> 34, 443. 59
July 1, 1889, balance available	593. 14
	<hr/> <hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	62, 500. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix O 8.)	

9. *Jekyl Creek, Georgia.*—The present project for the improvement of this creek was adopted in 1888, the object being to obtain a navigable channel through the creek 7 feet deep at mean low water. The cost of the improvement was estimated at \$38,500.

Prior to improvement the low-water depth at some places did not exceed 3 feet, with a mean rise and fall of tide of 7.1 feet.

No work was done prior to the last fiscal year.

During the fiscal year just closed 20,486.84 cubic yards were dredged from the mouth of the creek and the shoal inside, leaving a navigable channel not less than 5 feet deep at mean low water. The amount expended to June 30, 1889, including all outstanding liabilities, is \$4,766.95.

It is proposed during the coming year, with any funds which may become available, to complete the dredging and begin work on the training-wall and closing-dam.

Amount appropriated by act of August 11, 1888	\$5, 000. 00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$4, 758. 70
July 1, 1889, outstanding liabilities	8. 25
	<hr/> 4, 766. 95
July 1, 1889, balance available	233. 05
	<hr/> <hr/>
{ Amount (estimated) required for completion of existing project	33, 500. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	15, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix O 9.)	

10. *Cumberland Sound, Georgia and Florida.*—The present project for the improvement of the entrance to this sound was adopted in 1879,

the object being to secure a navigable low-water channel across the bar from 20 to 21 feet in depth. The cost of improvement was estimated at \$2,071,023.

Prior to improvement the low-water depths of the entrance varied from 11 to 12.5 feet, with a mean rise and fall of tide of 5.9 feet.

During the fiscal year just closed the south jetty was raised to the level of mean low water for a distance of about 3,000 feet from shore. The hydrographic survey of the harbor was completed. The expenditures during the year amounted to \$34,049.54. The total amount expended to June 30, 1889, including all outstanding liabilities, is \$413,616.24.

It is proposed during the coming year, with any funds which may become available, to raise the south jetty.

The amount estimated as necessary to complete the improvement is \$1,591,023.

July 1, 1888, amount available	\$1,005.74
Amount appropriated by act of August 11, 1888.....	112,500.00
	<hr/>
	113,505.74
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$34,049.54
July 1, 1889, outstanding liabilities.....	13,072.44
July 1, 1889, amount covered by existing contracts.....	60,657.08
	<hr/>
	107,779.06
July 1, 1889, balance available.....	<hr/>
	5,726.68
<hr/>	
{ Amount (estimated) required for completion of existing project	1,591,023.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	500,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix O 10.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The act of August 11, 1888, provides for examination and survey of *Savannah River, as to whether the damage to the Vernezobia freshet bank in eighteen hundred and eighty-seven was caused by the work at Cross Tides, and whether the maintenance of said bank is essential to the success of the work at Cross Tides, and what will be the cost of so constructing said bank as to confine the water of said river to its bed.* Lieutenant Carter was charged with and has completed this examination and survey, the results of which will be found in Appendix O 11.

It appearing from the report of the preliminary examination made by the local engineer that the following localities are worthy of improvement, and the public necessity therefor being apparent from the facts and reasons reported, which are concurred in by the Chief of Engineers, Lieutenant Carter was charged with their survey, the results of which will be submitted when received:

1. *Savannah River above Augusta, and between Augusta and Andersonville, Georgia.*
- 2. *Oconee River, Georgia.*
- 3. *Ocmulgee River, Georgia.*

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN THE STATE OF FLORIDA.

Officer in charge, Capt. William M. Black, Corps of Engineers, with Lieut. D. Du B. Gaillard, Corps of Engineers, under his immediate orders; Division Engineer, Col. William P. Craighill, Corps of Engineers.

1. *St. John's River, Florida.*—Operations for the improvement of this river have been carried on in conformity with a project submitted in 1879 by the late General Gillmore, colonel Corps of Engineers. The plan contemplates the formation of a continuous channel 15 feet deep at mean low water from Jacksonville to the ocean. The points where work is required are in a reach near Dame's Point, 12 miles from the mouth, and on the bar at the mouth. Near Dame's Point the mean low-water depth varies from 9 to 10 feet. The bar at the mouth is formed of sand. Before work began, the mean low-water channel depth across it varied from 5 to 7 feet, with a tidal range of 5 feet. The channel across the bar shifts continually north and south through a mile range. The work was divided in two parts, (1) the formation of a channel across the bar at the mouth, by the concentration and direction of the tidal currents by two jetties, to start from the opposite shores of the entrance, and to converge until, on the bar, their outer ends should be approximately parallel and 1,600 feet apart; and, (2) the improvement of the Dame's Point Reach. The estimated cost of the two parts is \$1,306,500 and \$120,000, respectively.

As the improvement at the mouth was at first most urgently required, the five appropriations up to that of 1886, inclusive, aggregating \$675,000, were made for improving "the channel over the bar at the mouth," under the estimate for that part of the total project. Since 1887 the depth on the bar has been greater than that in the Dame's Point Reach, and the interests of commerce have demanded that work at the latter point should be started. Accordingly, the appropriation in the act of August 11, 1888, was made for improving the river "from Jacksonville to the ocean, including the channel over the bar at the mouth," under the estimate for the entire project, of which \$576,500 remains to be appropriated.

On June 30, 1888, the south jetty had a total length of 6,667 feet, of which 4,100 feet were built to the level of mean low water. The north jetty had a total length of 6,585 feet, of which a length of 553 feet, including the shore extension, was at the full height and capped. With this exception, neither jetty has been built a full-sized cross-section. Both jetties are made of one or more layers of log or brush mattresses covered with riprap stone. Since 1886 oyster shells have been used as hearting. The total proposed lengths for the south and north jetties are 6,800 and 9,400 feet, respectively. The amount expended to June 30, 1888, was \$670,957.13. At that time a straight permanent channel had been secured across the bar, having a least mean low-water depth of from 12 to 13 feet. The channel depth across the bulkhead at the inner end of the jetties was from 11 to 12 feet.

Operations during the fiscal year ending June 30, 1889, comprised a survey of the Dame's Point Reach, on which to base a detailed project for its improvement, and the continuation of the work on the north jetty, under the contract with Mr. R. G. Ross, of Wilmington, N. C.; the foundation of the north jetty was extended 1,455.2 feet by brush fascine mattresses 120 feet wide, ballasted with stone, the narrow portion of the superstructure was strengthened and built up, and it was ex-

tended 1,065 feet by a mound of riprap stone with shell hearting. The length of the north jetty foundation is now 8,040.2 feet of the superstructure, built to the level of mean low water 6,697 feet. No work was done on the south jetty.

During the past fiscal year the north jetty channel, which occupies the position which it is believed the permanent jetty channel will take, has widened and deepened considerably, and at the present time a distance of but 1,500 feet, measured in the direction of flow of the ebb current, separates its inner 12-foot contour from the 12-foot contour of the present jetty channel across the bar.

The channel across the bar has also widened during the past year, the distance between the 10-foot contours on the edges of the bar channel being now 1,100 feet. The least width of this channel between 12-foot contours is 250 feet, and the least depth along its axis is 12.8 feet.

The jetty middle ground, west of Ward's Bank, has continued to aboal, and now has a least depth of 9.8 feet on the crossing to the south jetty channel; but it is hoped that the extension of the superstructure of the north jetty will cause that channel to unite with the present bar channel.

July 1, 1888, amount available	\$4, 042. 87
Amount appropriated by act of August 11, 1888	175, 000. 00
	<hr/> 179, 042. 87

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$57, 281. 55
July 1, 1889, outstanding liabilities	22, 960. 31
July 1, 1889, amount covered by existing contracts	57, 541. 93
	<hr/> 137, 783. 79

July 1, 1889, balance available	41, 259. 08
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{ Amount (estimated) required for completion of existing project	576, 500. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	300, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867	

(See Appendix P 1.)

2. *Volusia Bar, Florida.*—Volusia Bar is situated at the head of Lake George and is formed by materials brought down by the St. John's River and deposited at the point where the current of the narrow river loses its velocity as the bed widens to form the lake. The usual depth on the bar, before operations began, was from $3\frac{1}{2}$ to $4\frac{1}{2}$ feet with a very crooked channel. At times this depth was diminished so much as to stop navigation entirely.

The adopted plan of improvement was to contract the waters on the bar by the construction of two converging brush and stone jetties, with a view to causing a scour to the depth of 6 feet. Should the depth caused by the jetties not be sufficient, recourse was to be had to dredging. Between the jetties on the bar, lines of guide piles were placed to keep vessels off the jetties and to define the channel clearly.

In 1887 it was decided to limit the channel depth sought to the 5 feet then obtained, on account of the evident shoaling in the lake beyond the jetties and because that depth was sufficient for the requirements of the existing river commerce.

Up to June 30, 1888, \$24,646.44 had been expended, including liabilities then outstanding. The jetties had been built to their full length and to a height sufficient to produce the desired effect; two lines of firmly-set fender-piles defined the jetty channel on the crest of the bar, and a straight channel with a minimum mean low-water depth of 5 feet had

been obtained. During the fiscal year ending June 30, 1889, operations were limited to the necessary examinations, and repairs. At the last examination, made in March, 1889, the work was found to be in good condition, and the straight 5-foot channel had been well maintained. Since the improvement has been made boats have had no difficulty in passing this point. Operations during the coming year will be limited to the necessary repairs. The work can be maintained with an annual expenditure of \$500.

July 1, 1888, amount available	\$353. 56
Amount appropriated by act of August 11, 1888.....	500. 00
	<hr/>
	853. 56
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	149. 06
	<hr/>
July 1, 1889, balance available	704. 50
	<hr/>
{ Amount (estimated) required annually for maintaining work.....	500. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	500. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix P 2.)

3. *Harbor at St. Augustine, Florida.*—This is a new work. In compliance with the requirements of the river and harbor act of August 5, 1886, an examination and survey were made of "St. Augustine for a deep-sea channel on the outer bar," and the report of the results thereof was transmitted to Congress January 11, 1888, and printed in House Ex. Doc. No. 87, Fiftieth Congress, first session.

The project proposed for the improvement of the entrance is to concentrate the flow over the bar, and thus increase the scour by the construction of solid converging jetties, etc., at an estimated cost of \$1,467,888.

The river and harbor act of August 11, 1888, appropriated \$35,000 for improving the harbor, but directed that the subject be referred to a Board of Engineers, whose report was to be laid before Congress at its next session, together with the views of the Secretary of War and of the Chief of Engineers thereon. The report called for was duly submitted and is printed in House Ex. Doc. No. 138, Fiftieth Congress, second session. The Board "is of the opinion that the plan is well considered and promises success should funds be supplied with sufficient liberality to permit the work to be carried rapidly to completion." It is also stated that the harbor has fine interior facilities for becoming a commercial port, but that the bar being of shifting sand is difficult of improvement, that the estimated cost of the improvement is not excessive, that the work could be prosecuted to such an extent as to fix the channel and afford a probable increase of depth to 10 feet at mean low water for about \$925,000. It is therefore the opinion of the Board that the improvement is an expensive undertaking which it would be inexpedient to attempt until demanded by pressing needs of commerce. A statement of the present status of similar works along the southern coast is then submitted. It concludes that it is for the wisdom of Congress to decide whether it is expedient to undertake the improvement of the harbor at this time.

The Board recommends that the appropriation of \$35,000 be expended in stopping the erosion of the shores at the entrance to the harbor.

In all of the above views and recommendations the Chief of Engineers concurred.

The funds available will be spent in checking the erosion, as recommended by the Board.

Amount appropriated by act of August 11, 1888	\$35,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	628.93

July 1, 1889, balance available	34,371.07
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(See Appendix P 3.)

4. *Northwest entrance, Key West Harbor, Florida.*—A bar having a channel depth of 10.5 feet obstructs the northern entrance to this harbor. During storms the available depth is so much reduced that vessels bound to and from Gulf ports can not use it, but are compelled to make a détour of about 100 miles by Dry Tortugas to enter or leave the Gulf.

An examination of the entrance, with a view to its improvement, was made in 1867 and again in 1881. In 1882 Congress made an appropriation of \$25,000 for dredging a channel 300 feet wide and 17 feet deep across the bar. As was anticipated, the improvement was only temporary.

In act approved August 5, 1886, \$2,500 was appropriated for a new examination and survey of the bar. This was made in December, 1886, and January, 1887. The bar was found to be formed and maintained by interfering tidal currents. The project for its improvement comprised the construction of one or more training-walls, with dredging, if necessary.

In the act of August 11, 1888, Congress appropriated \$25,000 for this work, with the proviso that the Secretary of War should appoint a Board of three Engineer Officers, who should consider the subject and report on the advisability of continuing the work under the above project, and that he should submit the report, together with the views of himself and the Secretary of War thereon, to Congress at its next session.

A report was submitted and is printed in House Ex. Doc. No. 145, Fiftieth Congress, second session. The opinion of the Board, in which the Secretary of War and the Chief of Engineers concur, is that the work is one of national importance which it is expedient to undertake, and that the general method proposed promises success at a cost within reasonable limits, but that owing to the difficulty of the problem and the small sum which had been appropriated for its investigation, the data available were insufficient for fixing the details of the project. The engineer officer in charge was directed to obtain the additional information desired. The necessary field work was done in April, May, and June. As soon as the notes of the survey can be plotted a report will be submitted to the Board.

Amount appropriated by act of August 11, 1888	\$25,000.00
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July 1, 1889, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1888	\$5,854.13
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July 1, 1889, outstanding liabilities	117.55
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	5,971.68
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July 1, 1889, balance available	19,028.32
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{	Amount (estimated) required for completion of existing project, subject to revision	583,000.00
	Amount that can be profitably expended in fiscal year ending June 30, 1891	100,000.00
	Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix P 4.)

5. *Oaloosachatchee River, Florida*.—Before improvement, the lower part of the river was so obstructed by oyster bars that the available channel depth was only 5½ feet. About 17 miles above the mouth the river loses the characteristics of an estuary, and there are numerous islands and a broad shoal.

The project adopted in 1882 called for the formation, by dredging, of a channel 100 feet wide and 7 feet deep from the bay to Fort Meyers, a distance of 14 miles. In 1886 this project was modified so as to include the improvement of the upper river as far as Fort Thompson by removal of snags and overhanging trees.

Up to the close of the fiscal year ending June 30, 1888, \$13,809.92 had been expended under these projects. A channel of the required width, and having a least depth of 6 feet, had been formed below Fort Meyers, one of the worst reaches of the river, extending 4½ miles above Fort Denaud, had been cleared of snags and overhanging trees, and a survey of the river had been made. Owing to the presence of an epidemic in the State, no operations on the river were possible before the end of 1888. During the winter of 1888-'89, work was prevented by an unusually protracted season of high water. As the high-water season usually begins about July 1, field work has been postponed until the next low-water season. During the year a map of the river was made. Nine hundred and fifty-one dollars and twenty-six cents has been expended for engineering and office expenses and for plant.

July 1, 1888, amount available	\$190.08
Amount appropriated by act of August 11, 1888.....	10,000.00
	<hr/>
	10,190.08
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	951.26
	<hr/>
July 1, 1889, balance available	9,238.82

{ Amount (estimated) required for completion of existing project	3,600.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	3,600.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix P 5.)

6. *Pease River, Florida*.—This river rises about the center of Polk County, Florida, and flows southwest into Charlotte Harbor. For the last 12 miles of its course it has the characteristics of an estuary. The rest of the stream flows through a heavily wooded and sparsely populated country, and is much obstructed by fallen trees, snags, rocks, and bars. It is subject to great changes of level. During the low-water season not more than 14 inches to 24 inches of water can be relied on.

The project for its improvement, adopted in 1881, is to improve it for high-water navigation by the removal from the channel of snags, overhanging trees, and loose rocks between Fort Mead and the mouth, a distance by river of about 100 miles. In the Annual Report for 1888 the engineer in charge recommended the extension of the project to include the deepening of the channel at the entrance, so as to afford a depth of 11.5 feet at mean low water up to the railroad wharves at Punta Gorda. The estimated cost of clearing the upper river is \$25,000, and of dredging at the mouth, \$30,000.

Up to June 30, 1888, \$12,797.47 have been expended on this river. The only practical benefit from this expenditure is in a survey and map of the river. Snagging operations have been discontinued for several years owing to a lack of funds, and the channel opened has become

entirely choked. Navigation of the upper river is now practically impossible. One hundred and seventy-two dollars and twenty-eight cents has been expended during the past fiscal year for engineering and office expenses and for plant. No active operations have been possible for lack of funds.

July 1, 1888, amount available	\$202. 53
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	172. 28
July 1, 1889, balance available	30. 25
<hr/>	
{ Amount (estimated) required for completion of existing project.....	25,000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix P 6.)	

7. *Manatee River, Florida.*—The portion of the Manatee River under improvement is the lowest reach between Rocky Bluff and the mouth, a distance of about 12 miles. This has a mid channel depth of from 7 to 20 feet. The general width is about three-fourths of a mile. At the mouth is a long shoal with a minimum depth of 8½ feet. Between Palmetto and Manatee, about 6 miles from the mouth, is another bar covered by from 3 to 5 feet of water.

The river was examined in 1881. The project adopted had for its object to form a channel 100 feet wide and 13 feet deep at mean low water from Tampa Bay to McNeill's Point (Palma Sola). In 1883-'84 a cut 2,150 feet long was made across the bar at the entrance, varying in width from 35 to 60 feet, and having a depth of 12½ feet. This was not protected and has been filled by the tidal currents of Tampa Bay.

In act approved August 5, 1886, \$13,000 was appropriated for improving Manatee and Pease rivers, of which \$11,000 were allotted to work on Manatee River.

Owing to the changed commercial conditions since the adoption of the project, brought about by the extension of the railroad to Tampa, the transfer to Tampa of the principal Gulf steam-ship lines, and the service of the smaller towns around Tampa Bay by coasting steamers from Tampa, the project was modified, to provide for the passage of these lighter-draught vessels to all of the towns of the lower river by the removal of the bar above Palmetto. A cut 65 feet wide and 8 feet deep was made through this bar in the fall of 1887. A survey and map of the river were also made; \$22,384.13 had been expended to June 30, 1888. During the past fiscal year \$299.66 was expended. A contract for widening the cut near Palmetto has been made. Operations have not yet begun under the contract. At the last examination 8½ feet could be carried over the bars at the mouth of the river at mean low water. The cut near Palmetto had shoaled slightly at the ends, and deepened at the middle.

July 1, 1888, amount available	\$615. 87
Amount appropriated by act of August 11, 1888.....	5,000. 00
	5,615. 87
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	299. 66
July 1, 1889, amount covered by existing contracts.....	4,500. 00
	4,799. 66
July 1, 1889, balance available	816. 21

{ Amount (estimated) required for completion of existing project.....	\$45,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	8,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix P 7.)

8. *Tampa Bay, Florida.*—The harbor at Tampa, at the head of this bay, was separated from deep water by a flat 2 miles wide. Through this was a narrow channel with an average available depth of about 5 feet, formed by the waters of Hillsborough River.

The original project was adopted in 1879, and has for its object the formation of a 9-foot channel from the 9-foot curve in the bay to the wharves at Tampa, in Hillsborough River, 150 feet wide in the bay and 200 feet wide in the river, at an estimated cost of \$97,000.

Up to June 30, 1888, \$69,068.54 had been expended. The work consisted entirely of dredging and rock excavation, and extended over a distance of 8,200 feet, making a cut varying in width from 200 feet in the river to 60 feet in the bay. On June 30, 1887, it had a depth along its center line of from 8.3 to 9 feet. The depth in the flats beyond the outer extremity of the cut is 7 feet.

In the Annual Reports for 1887 and 1888 it was recommended, for reasons given, that work under this project beyond what is necessary to maintain the present channel should be suspended, and that Port Tampa, on the deep water of Old Tampa Bay, should be utilized as the deep-water port of Tampa. Fourteen and a half feet of water could then be carried to its wharves. The estimated cost for a channel 200 feet wide and 20 feet deep from there to the Gulf of Mexico was \$65,000.

In the act of August 11, 1888, \$25,000 was appropriated for "improving harbor at Tampa Bay, Florida, from outer bar to Mangrove or Bushy Point." From this action it is assumed that these recommendations have been approved by Congress, and that the modified project is "to maintain a channel 9 feet deep in Hillsborough Bay and Hillsborough River to the city of Tampa, and to form a channel 200 feet wide and with a mean low-water depth of 20 feet from the outer bar to Port Tampa (Little Mangrove or Bushy Point).

A survey made August 12 and 13, 1889, shows a channel 17 feet deep across the bars at the entrance to Old Tampa Bay, probably of very recent formation. This will diminish the quantity of material to be removed here so much as to allow the latter portion of the project to be completed with the sum now available. The estimated cost of completing the entire project is \$35,000. Nine hundred and four dollars and eighty-two cents was expended during the past fiscal year. A contract for dredging the channel through the bars at the mouth of Old Tampa Bay was made in March, 1889. Operations under the contract were begun June 29, 1889.

July 1, 1888, amount available.....	\$931.46
Amount appropriated by act of August 11, 1888.....	25,000.00
	<hr/>
	25,931.46
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	904.82
July 1, 1889, outstanding liabilities.....	253.67
July 1, 1889, amount covered by existing contracts.....	22,500.00
	<hr/>
	23,658.49
July 1, 1889, balance available.....	2,272.97
	<hr/>

{ Amount (estimated) required for completion of existing project	\$35,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	25,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix P 8.)

9. *Withlacoochee River, Florida.*—This river is 120 miles long and has a normal width varying from 75 to 180 feet, though at numerous points a defined channel is almost lost in broad marshy lakes and cypress swamps. The low-water depth varied from 1 to 7½ feet. Before improvement the river was so obstructed by loose rocks, snags, fallen trees, floating grass islands, and bars as to be practically impassable excepting in isolated reaches.

The river was examined with a view to its improvement in 1879. The approved project calls for the removal of snags, overhanging trees, loose rocks, and some of the worst shoals between the Gulf of Mexico and Pemberton Ferry, a distance of about 77 miles, so as to permit boats of 2 feet draught to navigate the river during one-half the year. Up to June 30, 1888, \$13,361.23 had been expended on this project. Some of the worst obstructions had been removed from the lower river, and the reach from Pemberton Ferry to Panasoffkee had been opened to navigation. During the past fiscal year \$981.67 was expended for current expenses and plant. Work will be commenced at an early date, when the services of the United States steam snag-boat recently constructed in the Suwanee River will be available. The officer in charge states that the growing commercial importance of the Withlacoochee River fully warrants the extension of the project so as to provide for navigation during the entire year, at an estimated cost of \$22,400.

July 1, 1888, amount available.....	\$138.77
Amount appropriated by act of August 11, 1888.....	5,000.00
	<hr/> 5,138.77
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	981.67
	<hr/> 4,157.10

{ Amount (estimated) required for completion of existing project.....	5,400.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	5,400.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix P 9.)

10. *Harbor at Cedar Keys, Florida.*—The improvement of this harbor has been carried on from time to time, under various appropriations made since 1872. It was obstructed by a shoal locally called the Bulkhead or Middle Ground, lying between Way Key and the main ship-channel; at several points in the main ship-channel the rock, which everywhere underlies the harbor at a slight depth, by its outcropping, has decreased the general 12-foot depth of the channels to from 7 to 9 feet. The present project for the improvement of the harbor was adopted in 1883, and contemplates the formation of a channel 200 feet wide and 10½ feet deep through these shoals. An appropriation of \$5,000 was made in 1884 for work under this project. With this a cut was made partially across one of these shoals. This cut has remained clear.

In act approved August 5, 1886, \$7,000 was appropriated for continuing this improvement. This amount was applied to reopening a cut through the Middle Ground, and changing its direction so as to insure greater permanence. The cut made in June, 1889, was 70 feet wide and 10½ feet deep. The last examination made showed that the cut had

been well maintained by the tidal currents; \$11,894.41 had been expended on this project up to June 30, 1888. During the past year \$378.95 was expended. Field-work was limited to the necessary examinations. A contract has been made for widening the cut with the funds now available.

July 1, 1888, amount available	\$105. 59
Amount appropriated by act of August 11, 1888.....	7,500. 00
	<hr/> 7,605. 59
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$378. 95
July 1, 1889, amount covered by existing contracts	6,500. 00
	<hr/> 6,878. 95
July 1, 1889, balance available	726. 64
{ Amount (estimated) required for completion of existing project.....	46,500. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	5,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix P 10.)	

11. *Suwanee River, Florida.*—A project for this improvement was adopted in 1880. It contemplates the formation of a channel 150 feet wide and 5 feet deep from the Gulf (through the bars at the passes) as far up the river as New Branford (Roland's Bluff). From there to Ellaville the channel is to be 60 feet wide and 4 feet deep.

Up to June 30, 1886, \$17,940 had been expended under contracts in dredging in the east pass. A channel 5,835 feet long, 60 feet wide, and 5 feet deep at mean low water had been cut.

By act of August 5, 1886, \$5,000 was appropriated for this work. This was expended on the channel between New Branford and Luraville, which was cleared and opened to the full size and width, excepting at one or two places where a small amount of work remains to be done. Up to June 30, 1888, \$22,556.34 had been expended. In the act of August 11, 1888, \$15,000 was appropriated for improving the Suwanee River, of which \$10,000 was to be expended for a self-propelling steam snag and dredge boat for use in the rivers of western Florida. This boat and a flat for a tender were built and equipped during the winter of 1888-'89. Early in May work was begun on the Derrick Island Pass at the mouth of the river. It was straightened and the channel was clearly marked with stakes. The boat was then taken to the upper river, and work was carried on above Luraville. During the past fiscal year \$12,689.12 has been expended. The remainder of the funds available will be expended between New Branford and Hudson.

July 1, 1888, amount available.....	\$443. 66
Amount appropriated by act of August 11, 1888.....	*15,000. 00
	<hr/> 15,443. 66
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$12,689. 12
July 1, 1889, outstanding liabilities.....	545. 66
	<hr/> 13,234. 78
July 1, 1889, balance available	2,208. 88
{ Amount (estimated) required for completion of existing project	27,158. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	5,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix P 11.)	

*Of this the sum of \$10,000 was to be used for the purchase of a snag-boat for use in the rivers of western Florida.

12. *Removing sunken vessels or craft obstructing or endangering navigation.*—An examination made in March, 1888, showed that obstructions endangering navigation existed at the following points, viz :

(1) Wreck of a United States transport, 18 miles south of Palatka.
(2) Portion of wreck of steamer *Maple Leaf*, 15 miles south of Jacksonville.

(3) Wreck of German brig near jetty channel, St. John's River, Florida. Authority to take the necessary steps for the removal of these obstructions, at an estimated cost of \$5,890, was granted April 23, 1888.

On May 2, 1888, application was made to postpone the work of removal till fall. This application was approved by the Department on May 10, 1888.

In November a contract for the removal of the wrecks was made. Work under the contract was begun in January.

The obstructions at the sites of the wrecks of the transport and of the *Maple Leaf* were removed promptly. Work on the wreck of the *Neva* was interrupted by stormy weather. A portion of the cargo of logwood of the *Neva* was recovered and will be sold. At the close of the fiscal year the wreck had not yet been removed, and an extension of time had been asked for by the contractor.

(See Appendix P 12.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examinations of the following localities were made by the local engineer in charge, Captain Black, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers, concurring in the conclusions reached in these instances, has given no instructions to make further survey with the view to their improvement:

1. *Homosassa River and bar at its mouth, Florida.*—(See Appendix P 13.)

2. *Crystal River and bar at its mouth, Florida.*—(See Appendix P 14.)

Captain Black also submitted a report of preliminary examination of *Alafia River and bar at its mouth, Florida*, provided for in the act, and the locality was reported by him to be in his opinion worthy of improvement, provided the detailed estimate does not show the cost of the work to exceed the sum of \$10,000.

Having carefully considered the report made by the local engineer, in my opinion this locality is not at present worthy of improvement; no instructions were therefore given for the survey proposed. (See Appendix P 15.)

At the following localities, reported by the local engineer as worthy of improvement, and this conclusion being concurred in by the Chief of Engineers, the result of the preliminary examination containing information sufficient to indicate to Congress the probable cost of the work required, no further report or survey appeared to be necessary:

1. *Ocklawaha River from its mouth to Lake Griffin, Florida.*—The improvement proposed consists of removal of snags, sunken logs, and overhanging trees, and of cutting off the worst bends; estimated cost, \$50,000. (See Appendix P 16.)

2 *St. Mark's River and Bar at its mouth, Florida.*—The improvement proposed consists of straightening the channel at the Devil's Elbow; removing rock obstructions and sand-bars, and deepening the channel through the bar opposite the mouth of Wakulla River, and removal of bowlders from channel in the immediate vicinity of Newport. Estimated cost, \$39,000. (See Appendix P 17.)

3. *The Channel between Tampa Bay and Old Tampa Bay, Florida.*—The improvement proposed at this locality is for connecting the deep waters of Old Tampa Bay and Tampa Bay by dredged cuts 200 feet wide and 20 feet deep at mean low water, at an estimated cost of \$63,000, of which amount \$25,000 was appropriated by the river and harbor act of August 11, 1888. (See Appendix P 18.)

It appearing from the report of the preliminary examination made by the local engineer that *Sarasota Bay, Florida*, is worthy of improvement, and the public necessity therefor being apparent from the facts and reasons reported, which are concurred in by the Chief of Engineers, Captain Black was charged with its survey, the results of which will be submitted when received.

IMPROVEMENT OF CERTAIN RIVERS IN THE STATES OF FLORIDA, GEORGIA, AND ALABAMA, OF APALACHICOLA BAY, AND OF HARBOR AT PENSACOLA, FLORIDA.

Officer in charge, Capt. R. L. Hoxie, Corps of Engineers, until January 17, 1879, since which date Capt. P. M. Price, Corps of Engineers. Division Engineer, Col. O. B. Comstock, Corps of Engineers.

1. *Apalachicola River, Florida.*—The approved project for the improvement of this river contemplated securing a channel 100 feet wide and 6 feet deep at low water, by removing snags and overhanging trees as well as widening and straightening Moccasin Slough.

The improvement is completed as projected, but at Moccasin Slough and the Upper and Lower Elbows further work is necessary to make good navigation, and it is estimated that this work can be done for \$5,000. To preserve the improvement already made, an annual sum of \$2,000 is required for the removal of the accumulation of snags and overhanging trees. The balance available will be used for this work during the fall of 1889, and the appropriation of \$2,000, asked for, will be applied to the maintenance of the existing improvement during the following year, and that of \$3,000 to the improvement of navigation at Moccasin Slough and Upper and Lower Elbows.

During the year ending June 30, 1889, the sum of \$929.17 has been expended.

July 1, 1888, amount available.....	\$687. 58
Amount appropriated by act of August 11, 1888.....	2, 000. 00
	<hr/> 2, 687. 58
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	929. 17
	<hr/> 1, 758. 41

{ Amount that can be profitably expended in fiscal year ending June 30, 1891 5, 000. 00
 { Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix Q 1.)

2. *Apalachicola Bay, Florida.*—A bar existed at the mouth of the Apalachicola River, extending from one-half mile below the town of Ap-

alachicola, Fla., to the lower anchorage. The minimum channel depth of water over this bar was $3\frac{1}{2}$ feet. The plan of improvement was the deepening of the channel to 11 feet with a width of 100 feet (see Annual Report of the Chief of Engineers for 1879, pages 823 and 824), at an estimated cost of \$100,000.

Up to June 30, 1888, the expenditure of \$66,756.51 of the amount appropriated for this work had resulted in a channel-way 3,635 feet long, 60 feet wide, and 9 feet deep at mean low water on the 18th of August, 1887. No work has since been done, and the dredged channel is steadily filling up, partly by the deposit of silt from the river and partly by the washing in of material from the sides of the cut by the bay currents. It is not thought that any dredged channel will be permanent, but it is probable that were the cut made 100 feet wide and 11 feet deep at one operation the silting would take place much less rapidly.

The act of August 11, 1888, appropriated \$20,000, which was insufficient to accomplish this, and it was therefore originally intended to hold this appropriation until another was made. An examination and survey made in March, 1889, however, showed that the channel had shoaled to a depth of 4 feet at mean low water and that the commerce of the port was so seriously inconvenienced that it was decided to expend the amount available. Proposals for dredging were advertised for on April 15, 1889, and opened on May 15, 1889. The only bid received was that of the Alabama Dredging and Jetty Company, of Mobile, Ala., at $24\frac{1}{2}$ cents per cubic yard. This bid was accepted, and it is expected that work will begin under the contract in July, and that a depth of 8 feet and a width of 100 feet will be obtained over the bar.

During the year ending June 30, 1889, the expenditure has been \$568.22 for expenses of survey and examination and for advertising for proposals.

July 1, 1888, amount available, including liabilities outstanding.....	\$243. 49
Amount appropriated by act of August 11, 1888.....	20, 000. 00
	<hr/> 20, 243. 49

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$568. 22
July 1, 1889, outstanding liabilities.....	3. 50
	<hr/> 571. 72

July 1, 1889, balance available	<hr/> 19, 671. 77
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{ Amount (estimated) required for completion of existing project.....	75, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	40, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix Q 2.)

3. *La Grange Bayou, Florida.*—The plan of improvement adopted was made pursuant to an examination of this bayou in 1881, under an act of Congress approved March 3, 1881, and contemplates the deepening of the channel through the bayou so as to admit of the passage of vessels drawing $4\frac{1}{2}$ feet at mean low water, the work to be done by dredging,

Up to June 30, 1888, there had been expended on this work the sum of \$2,000, allotted from the appropriation of \$20,000 made by an act approved August 2, 1882, for the improvement of the Choctawhatchie River, Florida. The result was the securing of a channel 5 feet in depth at mean low water, which has since shoaled to 4.9 feet.

The act of August 5, 1886, appropriated \$2,000 for this improvement. It was decided that this appropriation could be more profitably ex-

pending by holding it until an additional appropriation was made. The act of August 11, 1888, appropriated \$3,000 for completing the improvement of La Grange Bayou, including Holmes River up to the town of Vernon. An examination and partial survey made in February, 1889, showed that the completion of the improvement at La Grange Bayou would cost about \$12,000, and that the removal of the snags, logs, and overhanging trees from Holmes River would cost about \$3,000, exclusive of the cost of the necessary plant. These facts being submitted to the Secretary of War, he directed that no further expenditure should be made from these appropriations. Holmes River can be most economically cleared of obstructions by employing the plant, with certain modifications, now being provided for the Choctawhatchie River, using it during the high-water stages of the latter river, when it would otherwise be laid up. The needed modification of this plant would cost \$2,500. Should it be decided to improve Holmes River, it is recommended that it be associated with the Choctawhatchie River in such a way that the same plant can be used on both rivers.

During the year ending June 30, 1889, the sum of \$160.80 has been expended.

July 1, 1888, amount available.....	\$2, 000. 00
Amount appropriated by act of August 11, 1888	3, 000. 00
	<hr/>
	5, 000. 00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	160. 80
	<hr/>
July 1, 1889, balance available.....	4, 839. 20
	<hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1891, for improving Holmes River only	5, 500. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix Q 3.)	

4. *Harbor at Pensacola, Florida.*—In 1878 the channel was much obstructed by wrecks, and a survey made in 1879 showed a depth of 19 feet at mean low water, with about 150 feet width of channel across the inner bar. This depth was not sufficient to accommodate a large number of vessels seeking entrance to the port. The western shore of the entrance to the harbor, which is the site of old Fort McRee, was also fast washing away, and a large portion of the fort had disappeared. This widening of the channel was also causing it to shoal. The removal of the wrecks was begun in 1878.

The plan of improvement adopted in 1881 contemplates dredging a channel 300 feet wide and 24 feet deep at mean low water across the inner bar for temporary relief of the navigation of this harbor, and the preservation of the site of old Fort McRee, by the construction of suitable works of shore protection, with a view to retaining this position for defensive purposes and preventing further changes in the tidal currents through the continued abrasion of the shore at this point.

The expenditure up to June 30, 1888, of \$213,130.02 had resulted in obtaining temporarily a channel 120 feet wide and 24 feet deep at mean low water across the shoal inside the bar, and in stopping the abrasion of the shore line at Fort McRee. This channel was not maintained by the tidal currents, and on June 30, 1888, was reported to be about 22 feet in depth at mean low water, a gain of 2.6 feet over the depth existing when the work was commenced.

The enforced cessation of work on account of no appropriation for the

fiscal year ending June 30, 1888, resulted in further injury to the jetties and the postponement of relief to navigation.

During the year ending June 30, 1889, \$10,222.77 has been expended entirely on the work of shore protection. At the site of old Fort McRee, on account of the want of funds, the jetties were originally built with parallel piles filled with brush and stone. The toroedo has destroyed the piles and the storms have washed away the stone and brush until now not more than 25 per cent. of the original jetties remain. These jetties are being repaired by placing stone weighing from 100 to 400 pounds on the old foundation until they reach a height of 12 feet below mean low water, and then placing on this foundation a structure composed of heavy concrete blocks to the height of mean high water.

The available funds have not been sufficient to complete this work and also to do dredging profitably. The present depth on the inner bar channel is 21.2 feet at mean low water, showing a shoaling of eight-tenths of a foot in the past fiscal year. The width of the channel diminishes continuously by the advance of the Middle Ground Shoal upon this northern border. An annual outlay will be necessary to maintain the dredged channel until a permanent improvement of this harbor shall have been authorized by Congress.

July 1, 1888, amount available, including liabilities outstanding.....	\$1,869.00
Amount appropriated by act of August 11, 1888	35,000.00
	<hr/> 36,869.98
July 1, 1889, amount expended during fiscal year, exclusive of	
liabilities outstanding July 1, 1888	\$10,222.77
July 1, 1889, outstanding liabilities	2,489.54
	<hr/> 12,712.31
July 1, 1889, balance available.....	<hr/> 24,157.67
{ Amount (estimated) required for completion of existing project.....	40,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	40,000.00
{ Submitted in compliance with requirements of section 2 of river and	
harbor acts of 1866 and 1867.	

(See Appendix Q 4.)

5. *Choctawhatchie River, Florida and Alabama.*—The river was originally so much obstructed by logs, snags, overhanging trees, and rock and land shoals, that its commerce was represented by the traffic of one steamer of 100 tons burden, making irregular trips between Geneva, Ala., and Caryville, Fla.

The present plan of improvement was adopted in 1872, and modified in 1880, pursuant to an examination made under the act of March 3, 1879. It contemplates the improvement of the river from its mouth to Newton, Ala., an estimated distance of 252 miles, so as to obtain a low-water navigable channel from its mouth to Geneva, and a navigable high-water channel from Geneva to Newton, Ala.

The expenditure up to June 30, 1888, of \$34,798.84, has resulted in giving a navigable channel at mean low water from the mouth of the river to Geneva, and a partially improved channel from Geneva to Pate's Creek, a distance of 25 miles (12 miles below Newton, Ala.).

During the year ending June 30, 1889, \$3,697.35 has been expended. The channel between Geneva and Caryville was cleared of its worst obstructions between July and November, 1888. In May, 1889, work was begun between Geneva and Newton, and is now being carried on. A contract has been entered into with M. A. Sweeney & Bro., of Jeffersonville, Ind., for the building of a new snag-boat for \$4,800. It should be completed and delivered on July 10, 1889, and will then

work between Geneva and Caryville until the funds available are exhausted.

July 1, 1888, amount available, including liabilities outstanding.....	\$2,211. 16
Amount appropriated by act of August 11, 1888.....	10,000. 00
	<hr/> 12,211. 16

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$3,697. 35
July 1, 1889, outstanding liabilities.....	869. 52
July 1, 1889, amount covered by existing contracts.....	4,800. 00
	<hr/> 9,326. 87

July 1, 1889, balance available.....	<hr/> 2,844. 29
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{ Amount that can be profitably expended in fiscal year ending June 30, 1891	15,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1897.	

(See Appendix Q 5.)

6. *Escambia and Conecuh rivers, Florida and Alabama.*—The river originally was much obstructed by snags, sunken logs, and rock shoals, and by a very shoal bar at the mouth. Steam-boat navigation was not attempted and rafts had much difficulty in passing down the river.

The plan of improvement for this river, adopted pursuant to partial examinations and surveys made in 1878 and 1879, contemplates the removal of snags and sunken logs and other obstructions from the channel, closing cut-offs and cutting through rock shoals from the mouth of the river in Pensacola Bay to the mouth of Indian Creek, an estimated distance of 273 miles, for the purpose of facilitating the movement of timber down the river, affording at the same time facilities for steam-boat navigation.

The expenditure up to June 30, 1888, of \$45,325.28, has resulted in dredging a channel through the bar at the mouth of the river and in the removal of obstructions to navigation, so that at the present time the river is navigable at ordinary stages for steam-boats drawing 5½ feet of water from Ferry Pass to Skinner's Landing, a distance of 17 miles, and for boats drawing 3 feet, to the Alabama State line, and the river has been so far cleared of logs, snags, and overhanging trees that the lower 118 miles is in a good navigable condition for stages of water above a 2½-foot stage. A new steamer has just been built at Pensacola to trade between Brewton and Andalusia on the upper river.

A survey of the bar at the mouth of the river made in April, 1889, showed that considerable shoaling had taken place there, and that it will be necessary to remove about 6,000 cubic yards of material to restore the channel to a depth of 7 feet.

During the fiscal year ending June 30, 1889, \$5,897.35 was expended upon this improvement. The result was the river has been cleared of all logs and snags and overhanging trees which were obstructions to navigation from its mouth to 81 miles above, and a survey was made of the bar at the mouth of the river to determine the amount of dredging that will be required to give relief to navigation; the trade of this stream at this point is confined exclusively to lumber.

July 1, 1888, amount available, including liabilities outstanding.....	\$3,811. 02
Amount appropriated by act of August 11, 1888.....	10,000. 00
	<hr/> 13,811. 02

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$5,897. 35
July 1, 1889, outstanding liabilities.....	575. 55
	<hr/> 6,472. 90

July 1, 1889, balance available.....	<hr/> 7,338. 12
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{ Amount (estimated) required for completion of existing project	\$25,430.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	15,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix Q 6.)	

7. *Flint River, Georgia.*—Originally the river was only navigable at low water from its mouth up to Bainbridge, and even that portion was narrow, crooked, and dangerous. Above Bainbridge it was very much obstructed by logs, snags, overhanging trees, and rock shoals.

The present project for the improvement of this river was adopted in 1873, and modified in 1880, the object of the original project being to afford a channel 100 feet wide and 3 feet deep at ordinary low water from its mouth up to Albany, Ga., and of the modification to improve for high-water navigation that portion of the river between Albany and Montezuma.

The expenditure up to June 30, 1888, of \$113,917.23 has resulted in obtaining a high-water channel from its mouth up to Albany and a low-water channel of the projected depth from its mouth up to Blue Springs Shoals, about 4 miles below Albany; also a partially completed high-water channel over that portion of the river between Albany and Montezuma.

During the year ending June 30, 1889, \$8,446.53 was expended. A channel of the required depth was excavated through Blue Springs Shoals nearly to Albany. On account of the want of plant no work was done above Albany. A new plant, consisting of snag-boat, drilling barge, and dumping flat, has been contracted for, and should be delivered on July 10, 1889.

July 1, 1888, amount available, including liabilities outstanding	\$3,112.53
Amount appropriated by act of August 11, 1888	20,000.00
	<hr/> 23,112.53

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$8,446.53
July 1, 1889, outstanding liabilities	634.50
July 1, 1889, amount covered by existing contracts	8,200.00
	<hr/> 17,281.03

July 1, 1889, balance available	5,831.50
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{ Amount (estimated) required for completion of existing project	62,962.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	30,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix Q 7.)

8. *Coosa River, Georgia and Alabama.*—The river was originally much obstructed by rock shoals and sand bars between Rome and Greensport, and below Greensport it was not navigable at all on account of such obstructions.

A plan was adopted in 1875 to provide a channel not less than 80 feet wide and 3 feet deep at low water between Rome, Ga., and the Selma, Rome and Dalton Railroad Bridge, an estimated distance of 236 miles, increasing the depth over the lesser rock shoals and over sand and gravel bars by excavation and by works of contraction, and overcoming the more serious obstructions by the construction of locks and dams.

The expenditure up to June 30, 1888, of \$461,155.50 had resulted in securing a fair navigable channel from Rome, Ga., to Greensport, Ala., by blasting out the rock shoals and by the construction of wing-dams for clearing out the sand bars. Below Greensport a system of slack-

water navigation was provided for by the construction of locks and dams. Three masonry locks, at distances, respectively, of 0.68, 3.86, and 5.24 miles below Greensport, had been nearly completed with their dams, and a fourth lock and dam, 21 miles below Lock No. 3, had been commenced. The completion of the first three locks, with the dam at Lock 4, will give access from Rome, Ga., to the Coosa River coal-fields.

During the year ending June 30, 1889, the expenditure of \$26,839.84 has resulted in the practical completion of Locks 1, 2, and 3, some modifications in the valves only being required to open them to navigation. The act of August 11, 1888, provided for a survey of the river from Lock 4 to Wetumpka, with estimates for its improvement. This survey is now in progress. Lock 4 will be the first lock in the down-stream navigation should the river be opened to Wetumpka, and it is proposed to increase its dimensions to 52 feet by 322 feet.

The building of Lock 4, with the opening of the river below it to Wetumpka, will provide water transportation from the Coosa River coal-fields to the Gulf at Mobile, Alabama, by way of the Alabama River.

July 1, 1888, amount available, including liabilities outstanding.....	\$2,544.50
Amount appropriated by act of August 11, 1888.....	60,000.00
	<hr/> 62,544.50

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$26,839.84
July 1, 1889, outstanding liabilities	5,033.88
	<hr/> 31,873.72
July 1, 1889, balance available	30,670.78

{ Amount (estimated) required for completion of existing project.....	225,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	225,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.....	

(See Appendix Q 8.)

9. *Chattahoochee River, Georgia and Alabama.*—The river was originally much obstructed by logs, snags, overhanging trees, and by a number of rock and marl shoals and sand-bars, so that navigation was difficult and dangerous. Steam-boats could only run by daylight, and were then often detained for days by a single obstruction. Very many were lost by striking snags or logs.

The present plan of improvement (adopted in 1873) contemplates a low-water channel 4 feet in depth and 100 feet in width from Columbus, Ga., to Chattahoochee, Fla., a distance of 224 miles, by the removal of snags and other obstructions from the channel and overhanging trees from the banks, by the excavation of rock shoals, and by works of contraction.

Previous to the act of June 18, 1878, \$70,000 was appropriated for "Chattahoochee and Flint rivers," but it is not known how the amount was apportioned.

Up to June 30, 1888, \$150,134.04 of the appropriations for the Chattahoochee River alone had been expended, and with its share of the combined appropriations had resulted in securing a fair navigable channel between Chattahoochee and Eufaula at all seasons of the year, and between Eufaula and Columbus at all times except during the prevalence of extreme low water. Steam-boats now make regular trips with but few accidents or detentions, running by night as well as by day. The limited annual appropriations for this improvement have not been sufficient to maintain the works of contraction constructed, nor

to extend or modify them as required. The jetties and training walls are in need of much repair.

During the year ending June 30, 1889, \$10,507.57 has been expended in maintaining the existing improvement, excavating rock shoals, and in procuring new plant to replace that worn out.

July 1, 1888, amount available, including liabilities outstanding.....	\$2,884. 17
Amount appropriated by act of August 11, 1888.....	20,000. 00

22,884. 17

July 1, 1889, amount expended during fiscal year, exclusive of	
liabilities outstanding July 1, 1888.....	\$10,507. 57
July 1, 1889, outstanding liabilities.....	729. 72
July 1, 1889, amount covered by existing contracts.....	3,400. 00

14,637. 29

July 1, 1889, balance available.....	8,246. 88
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{ Amount (estimated) required for completion of existing project.....	182,247. 66
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	40,000. 00
{ Submitted in compliance with requirements of sections 2 of river and	
harbor acts of 1866 and 1867.	

(See Appendix Q 9.)

10. *Tallapoosa River, Alabama.*—The condition of this river when first examined was such that navigation was entirely suspended at low water, owing to the great accumulation of logs, snags, sunken and fallen-in timber, a large number of overhanging trees obstructing the channel, gravel and sand-bars, and at some points reefs of rock crossing the river, thus rendering navigation dangerous if not impracticable. The river presented generally long reaches of fine open navigable water with a width of 200 to 300 feet and a depth of 6 to 12 feet, and when this width was exceeded to any extent shoal water was found with gravel and island bars.

The original project adopted pursuant to an examination and partial survey of this river, made under an act of Congress approved June 14, 1880, contemplated obtaining a navigable channel from the mouth of the river to the foot of the Tallassee Reefs, 2 miles below the town of Tallassee, a distance of 48 miles, with a least depth of 3 feet and a width of 60 feet at low water, by the removal of logs and snags from the channel and of all overhanging timber from the banks where they interfere with navigation, by cutting through the soft rock that obstructed the river at several points, by contracting the channel at various shoal places with dams, jetties, and dikes, and also building such shore protection as might be found necessary. The present project, approved September 13, 1888, provides for a detailed survey of this river with permanent stations and bench-marks at intervals of about 1 mile, in connection with the original project, but has not yet been made on account of insufficiency of funds.

The expenditure of \$30,700.86, up to June 30, 1888, resulted in clearing out all logs and snags from the river channel, and in improving one of the rock-reefs, so as to admit of navigation at a moderate stage of water for a distance of 48 miles from the mouth of the river.

The amount expended during the fiscal year ending June 30, 1889, was \$5,136.48, and resulted in clearing the channel from its junction with the Coosa to the foot of Tallassee Reefs, a distance of 48 miles, of all snags and logs brought in during the winter freshets, and the removal of a considerable amount of overhanging timber from the banks, rendering the river navigable for small boats of 20-inch draught during the entire year.

July 1, 1888, amount available, including liabilities outstanding.....	\$1,817.14
Amount appropriated by act of August 11, 1888	7,500.00
	<hr/> 9,317.14
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$5,136.48
July 1, 1889, outstanding liabilities	387.52
	<hr/> 5,524.00
July 1, 1889, balance available	<hr/> 3,793.14
<hr/>	
{ Amount that can be profitably expended in fiscal year ending June 30, 1891, for maintenance and survey.....	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix Q 10.)	

11. *Cahaba River, Alabama.*—Under the act of Congress approved June 23, 1874, and an act approved June 14, 1880, examinations and a partial survey of this river were made in 1874 and in 1880, pursuant to which the present plan of improvement was adopted. This contemplates a channel 60 feet wide and 3 feet deep at low water from the mouth of the river to Centreville, Ala., a distance of 88 miles, by the removal of logs and snags from the channel, cutting overhanging trees from the banks, protecting caving banks from further erosion, removing rock-reefs, gravel-bars, and sand-bars, by excavation, and by works of contraction and widening the narrow portions of the river at certain specified points.

The expenditure up to June 30, 1888, of \$29,698.15 had resulted in clearing the river channel of logs and snags, and removing overhanging trees from the mouth of the river to Centreville, and in maintaining this degree of improvement up to close of the fiscal year ending June 30, 1886. Since that time no work has been done because of a proviso in the river and harbor act of August 5, 1886, that "no part of said sum (\$7,500 appropriated for this work) shall be expended until the officer in charge shall have reported that the railroad and other bridges across said river have been provided with good and sufficient draw openings." These bridges continue to obstruct the navigation of the river, not having been provided with draw openings. The working plant of the Cahaba River has been transferred to the Escambia and Conecuh improvement.

July 1, 1888, amount available.....	\$7,801.85
July 1, 1889, balance available.....	7,801.85
	<hr/>
{ Amount (estimated) required for completion of existing project.....	157,560.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	20,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix Q 11.)	

12. *Alabama River, Alabama.*—The original condition of the river channel during the low-water season was such that commerce was much restricted, the smallest class of steam-boats only running, navigation being difficult and dangerous. These restrictions were caused by the innumerable bars, shoals, reefs, and collection of sunken logs and snags, at many of which points the low-water depth was reduced to $3\frac{1}{2}$ feet, and at some points to $2\frac{1}{2}$ feet. The width of the channel varies with the width of the river. The general width of the river from the mouth of the Coosa down to Gainestown ranges from 500 to 600 feet; below that point the width increases to 700 and 800 feet; wherever these widths

are exceeded to any extent are found the bars, shoals, and reefs. In the open reaches of the river ample water is found. That portion below the Cut-Off, 20 miles in length, was absolutely inaccessible during low water, and all the landings situated thereupon were deprived of reliable service during that season.

The plan of improvement adopted pursuant to an examination and partial survey of this river, made under an act of Congress approved March 3, 1875, contemplated obtaining a channel 200 feet in width and 4 feet in depth at low water from the mouth of the Alabama, 50 miles above Mobile, to Wetumpka, Ala., a distance of 387 miles, by the removal of snags, logs, etc., from the channel, cutting overhanging trees from the banks, protecting caving banks from further erosion, removing rock-reefs, gravel and sand-bars by blasting, dredging, and works of contraction at certain specified points of the river. The present project, approved September 13, 1888, provides for a detailed survey of this river, with permanent stations and bench marks at intervals of about 1 mile, in connection with the original project, but has not yet been made on account of insufficiency of funds.

The expenditure of \$142,712.56, up to June 30, 1888, resulted in clearing the river of all dangerous snags, overhanging timber, in the improvement of the worst bars, in opening 20 miles of the river below the Cut-Off, before inaccessible during low water, in an increased safety to navigation, greater regularity and reduction in time of trips, and enabling boats to carry larger loads.

During the year ending June 30, 1889, \$8,882.52, was expended in maintaining the existing improvements.

July 1, 1888, amount available, including liabilities outstanding	\$2,287.44
Amount appropriated by act of August 11, 1888	20,000.00
	<hr/> 22,287.44

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$8,882.52
July 1, 1889, outstanding liabilities	891.41
	<hr/> 9,773.93

July 1, 1889, balance available	12,513.51
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{	Amount (estimated) required for completion of existing project (subject to revision)	200,000.00
	Amount that can be profitably expended in fiscal year ending June 30, 1891	40,000.00
	Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866, and 1867.	

(See Appendix Q 12.)

13. *Removal of sunken vessels or craft obstructing or endangering navigation.*—A fragment of wreckage from the middle-ground entrance to Pensacola Harbor was removed by the contractor, Mr. William Hughes, of Warrington, Fla. The work was completed in November, 1888.

(See Appendix Q 13.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 5, 1886.

The river and harbor act of August 5, 1886, provided for the *resurvey of outer and inner bars at Pensacola, Florida*, and the following paragraph in reference thereto is quoted from my annual report for the fiscal year ending June 30, 1888:

Under the provisions of section 6 of the river and harbor act approved August 5, 1886, Captain Hoxie was charged with *resurvey of outer and inner bars at Pensacola, Fla.*, which has not yet been completed owing to insufficient amount of the allotment

practicable for this purpose from the appropriation for examinations and surveys made by the act. The officer in charge, in a communication to this office dated March 7, 1888, recommended a specific appropriation of \$5,000 for the purpose of making proper survey and examination of this locality, and his communication was transmitted to Congress from the War Department March 15, 1888, and printed as House Ex. Doc. No. 226, Fiftieth Congress, first session.

The appropriation asked for was not granted, and the resurvey was therefore completed as thoroughly as practicable with the small allotment available, and the results submitted in report of Captain Price, successor to Captain Hoxie, in charge of the work, dated February 8, 1889. (See Appendix Q 14.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examinations of the following localities were made by the local engineer in charge, Captain Price, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers, concurring in the conclusions reached in these instances, has given no instructions to make further survey with the view to their improvement:

1. *St. Andrew's Bay, Florida.*—(See Appendix Q 15.)
2. *Chipola River, Florida, from its mouth to Marianna.*—(See Appendix Q 16.)

At the following localities reported by the local engineer as worthy of improvement, and this conclusion being concurred in by the Chief of Engineers, the result of the preliminary examination containing information sufficient to indicate to Congress the probable cost of the work required, no further report or survey appeared to be necessary:

1. *Chipola River, Florida, from its mouth to Wewahitchka and the "Cut-Off" and "Lee's Slough," running from the Apalachicola River to the Chipola River.*—The improvement proposed contemplates the removal of overhanging trees, logs, and snags and the widening of the channel in some places in "Lee's Slough." Estimated cost \$7,500. (See Appendix Q 16.)

2. *Flint River, Georgia; Rock reefs at Albany and above.*—The obstructions consist of nine reefs or shoals situated between Albany and Warwick, but until the effect upon the river above of the removal of the shoals below Albany is determined, it is not considered wise to do any work upon the shoals above further than the removal of loose rock from the channel. (See Appendix Q 17.)

3. *Choctawhatchee River, Alabama, for low-water navigation.*—As the existing project for the improvement of this river provides for a low water channel from its mouth to Geneva, the present examination extended only from Geneva to Newton, and contemplates a low-water channel 3 feet deep and 60 feet wide between those points at an estimated cost of \$57,125. No improvement of the river above the Hollis Bridge should, however, be undertaken until that structure is provided with a suitable draw. (See Appendix Q 18.)

It appearing from the report of the preliminary examination made by the local engineer for the location of a channel in and along the Coosa River, Alabama, from the rapids at Wetumka to connect with the improvements already completed on said river, above the Ten Islands, etc., that the locality is worthy of improvement, and the public necessity therefor

being apparent from the facts and reasons reported, which are concurred in by the Chief of Engineers, Captain Price was charged with its survey, the results of which will be submitted when received.

IMPROVEMENT OF THE HARBOR OF MOBILE, OF WARRIOR, TOMBIG-BEE, AND BLACK WARRIOR RIVERS, ALABAMA, AND OF CERTAIN RIVERS IN MISSISSIPPI—IMPROVEMENT OF CHANNEL TO BILOXI BAY.

Officer in charge, Maj. A. N. Damrell, Corps of Engineers. Division Engineer since December 3, 1888, Col. C. B. Comstock, Corps of Engineers.

1. *Mobile Harbor, Alabama.*—The present project for the improvement of this harbor was adopted in August, 1888, the object being to afford a channel of entrance from the Gulf of Mexico to the city of Mobile of 280 feet width on top of cut, with a central depth of 23 feet at mean low water. The channel had originally a minimum depth of 5½ feet through Choctaw Pass and 8 feet on Dog River Bar.

This was deepened by dredging, under appropriations from 1826 to 1852 of \$228,330.68, to 10 feet through both.

In 1860 the channel in Choctaw Pass had shoaled to 7½ feet.

From 1870 to 1878 the channel was deepened by dredging to 13 feet, under appropriations amounting to \$401,000. From 1881 to 1888 the channel was deepened by dredging to 17 feet, under appropriations amounting to \$740,000, but this project was not completed when the new project was adopted.

Considerable shoaling took place in a portion of this cut and deepening in another portion. Although 14 feet was found as the minimum actual depth, the available depth has never been less than 16 feet, as shown by the constant passage of vessels of that draught up to the present time.

The amount expended during the fiscal year ending June 30, 1889, is \$119,331.73, and resulted in obtaining a minimum depth of 19 feet for a distance of 12.9 miles, or about half of the entire length of the projected channel.

The minimum depth in any portion of the channel is now 15.5 feet; last year it was 14 feet.

The estimated cost of the present project is as follows:

Completion of 17-foot channel (including removal of material filled in the cut) upon which the estimate for the 23-foot cut was based	\$292,000
Dredging channel 280 feet wide on top of cut, and central depth of 23 feet ..	1,500,000
Removing material that will fill in during progress of work on 23-foot channel (three years)	198,000
	<hr/> 1,990,000

The amount available and appropriation asked for is to be applied to continuing the improvement in accordance with the modified project.

July 1, 1888, amount available	\$157.84
Amount appropriated by act of August 11, 1888	250,000.00
	<hr/> 250,157.84
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$119,331.73
July 1, 1889, outstanding liabilities	23,838.31
July 1, 1889, amount covered by existing contracts	97,511.77
	<hr/> 245,681.81
July 1, 1889, balance available	<hr/> 4,476.03

{ Amount (estimated) required for completion of existing project.....	\$1,730,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891.....	500,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix R 1.)

2. Black Warrior River, Alabama, from Tuscaloosa to Daniel's Creek.—The present project for the improvement of this section of the river was adopted in 1886, the object being to afford a water-way for the transportation of coal in barges from the Warrior coal-fields to the Gulf of Mexico.

The present channel is only navigable during very high water, and is even then extremely dangerous.

The amount expended to June 30, 1888, was \$11,645.35. This was used in necessary surveys; preparation of plans and estimates; acquisition of land for site for Lock No. 1; erection of lock tender's house, and buildings required for quarters, kitchen, store-rooms, tool-rooms, cement warehouses, blacksmith shop and shed, and construction of two boats; partial clearing of lock-site; partial excavation of foundation pit for bank wall; partial stripping of quarry; partial grading of track from lock to quarry, and partial construction of coffer-dam.

The amount expended during the fiscal year ending June 30, 1889, is \$122,475.68 and was used in the completion of the work mentioned above as partially performed; laying track from the lock to the quarry, 1½ miles; making two inclines from the bank into the lock chamber; framing and setting up of 19 derricks; construction of boat for derrick and two barges; quarrying of 7,811 cubic yards of stone; cutting of 2,364 cubic yards of stone; laying of 1,434 cubic yards of masonry; excavation of 816 cubic yards of rock and 1,500 cubic yards of earth in foundation.

All the stone for completing Lock No. 1 is now ready, except about one-half of that needed for coping and miter wall.

The estimated cost of the project is \$741,670.

The appropriation asked for and the amount available is to be applied to the completion of Lock No. 1 and construction of the others in order.

July 1, 1888, amount available.....	\$94,604.65
Amount appropriated by act of August 11, 1888	100,000.00
	<hr/> 194,604.65
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$122,475.68
July 1, 1889, outstanding liabilities	9,844.01
	<hr/> 132,359.69
July 1, 1889, balance available.....	62,244.96

{ Amount (estimated) required for completion of existing project.....	535,420.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891.....	300,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix R 2.)

3. Warrior and Tombigbee Rivers, Alabama and Mississippi.—(a) **Warrior River, Alabama.**—The present project for the improvement of this river was adopted in 1875, the object being to obtain a channel 4 feet deep and 80 feet wide at ordinary low water from its junction with the Tombigbee River up to Tuscaloosa.

The channel at that time was not navigable at low water and was much obstructed at a medium stage.

The amount expended to June 30, 1888, was about \$116,085 (exact figures can not be given, as for the years 1875-1882, inclusive, the appropriation was made for the Warrior and Tombigbee rivers jointly without any special allotment for each, and therefore no separate account was kept), and resulted in obtaining a channel safely and easily navigable at a stage of water fully 3 feet lower than was formerly practicable, enabling boats of 3 feet draught to run when the water is 1 foot above ordinary low water. The amount of \$624.33 was expended during the fiscal year ending June 30, 1889, in preparing maps, plans and estimates, and care of property.

July 1, 1888, amount available.....	\$302.96
Amount appropriated by act of August 11, 1888.....	18,000.00
	<hr/> 18,302.96
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	624.33
July 1, 1889, balance available	<hr/> 17,678.63
{ Amount (estimated) required for preservation of improvement	8,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	8,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix R 3.)	

(b) *Tombigbee River, Alabama, from Walker's Bridge to Fulton.*—The present project for the improvement of this section of the river is to open a channel for high-water navigation by the removal of snags and cutting overhanging timber:

The channel was originally only navigable for small rafts and very troublesome for them.

The amount expended to June 30, 1889 (the work having been commenced in the fiscal year), is \$2,676.72, and has resulted in improving about one-third of the entire distance according to the project.

The amount available and the appropriation asked for are to be applied to continuing the improvement according to the approved project.

Amount appropriated by act of August 11, 1888.....	\$4,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	2,676.72
July 1, 1889, balance available	<hr/> 1,323.28
{ Amount (estimated) required for completion of existing project	7,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	7,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix R 3.)	

(c) *Tombigbee River from Fulton to Vienna.*—The project for the improvement of the river between Columbus and Fulton was adopted in 1873, the object being to give a good high-water navigation throughout by the removal of snags and overhanging trees.

The channel before improvement was not navigable at all from Fulton down to Cotton Gin Port. From Cotton Gin Port down to Aberdeen, about 35 miles, it was navigable for small barges carrying about 125 bales of cotton. From Aberdeen to Columbus, about 65 miles, navigation was difficult when the river was 12 feet above ordinary low water.

The project for the improvement of the portion of the river between

Columbus and Vienna was adopted in 1879, the object being to afford a channel of navigable width 3 feet deep during ordinary low water.

Before the improvement was commenced the channel was much obstructed by snags and overhanging trees, and there was only 1 foot of water on some of the bars during ordinary low water.

The amount expended to June 30, 1888, was about \$78,651.38 (exact figures can not be given for reasons stated in Warrior River report), and resulted in the completion of the proposed improvement (during the year 1886, in preservation of improvement already obtained) of that section of the river from Fulton down to Columbus and in giving such a channel from Columbus down to Vienna that navigation was possible on a 2-foot rise for boats drawing 3 feet, and the accomplishment of over one half of the work.

The amount of \$863.03 was expended during the fiscal year ending June 30, 1889, in preparation of maps, plans, and estimates and preservation of property.

The amount available and the appropriation asked for are to be expended in preservation of the improvement.

July 1, 1888, amount available.....	\$898.67
Amount appropriated by act of August 11, 1888	6,500.00
	<hr/>
	7,398.67
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	863.03
	<hr/>
July 1, 1889, balance available.....	6,535.64
	<hr/>
{ Amount (estimated) required for preservation of improvement.	8,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	8,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix R 3.)

(d) *Tombigbee River, below Vienna.*—The project for the improvement of this portion of the river was adopted in 1879, the object being to afford a channel of navigable width and 4 feet deep at ordinary low water from the mouth up to Demopolis and 3 feet deep from Demopolis up to Vienna. Before the improvement was commenced the river was navigable from the mouth up to Bladon Springs, 143 miles above Mobile, during the entire year, but was obstructed by snags from Bladon Springs up to Demopolis; 243 miles above Mobile navigation was suspended about two months yearly during low water.

From Demopolis up to Vienna the channel was much obstructed by snags and overhanging trees, and water was so shoal on the bars that navigation was only attempted on a considerable rise. A railroad bridge at Jones' Bluff also gave considerable trouble.

The amount expended to June 30, 1888, was about \$106,459.31 (exact figures can not be given for reasons stated in Warrior River report), and resulted in obtaining an unobstructed channel with 3 feet depth of water from the mouth up to Tompkins' Bluff, 197 miles above Mobile, with 2 feet depth up to Kirkpatrick's, 260 miles above Mobile, and 1 foot depth (at ordinary low water) up to Vienna. A considerable portion of the sum has been used in preservation of the improvement previously made.

The amount expended during the fiscal year ending June 30, 1889, is \$1,521.64, in preparation of maps, plans, and estimates and care of property.

The amount available and appropriation asked for are to be expended in preservation of the improvement.

July 1, 1888, amount available.....	\$102.26
Amount appropriated by act of August 11, 1888.....	6,000.00
	<hr/> 6,102.26
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	1,521.64
July 1, 1889, balance available.....	<hr/> 4,580.62
<hr/>	
{ Amount (estimated) required for completion of existing project.....	8,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	8,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix R 3.)	

4. *Norubee River, Mississippi.*—The present project for the improvement of this river was adopted in 1880, the object being to afford a channel for small river steamers from its mouth up to Macon, Miss., of navigable width and depth when the water is above ordinary low-water stage.

The amount expended to June 30, 1888, was \$43,463.80, and resulted in obtaining a channel, partially improved, from the mouth of the river up to Macon, and a wholly improved channel (according to project) from Macon down to a point 28 miles below, and from the mouth of the river to a point 35 miles above, giving a river 65½ miles wholly improved and 26 miles partially improved.

The amount expended during the fiscal year ending June 30, 1889, is \$4,063.72, and resulted in the completion of the improvement of the river below Macon.

All work hereafter will be for the maintenance of the improvement.

July 1, 1888, amount available.....	\$1,536.20
Amount appropriated by act of August 11, 1888.....	5,000.00
	<hr/> 6,536.20
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	4,063.72
July 1, 1889, balance available.....	<hr/> 2,472.48
<hr/>	
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	3,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix R 4.)	

5. *Pascagoula River, Mississippi.*—The present project for the improvement of this river was adopted in 1886, the object being to afford a channel of navigable width and minimum depth of 12 feet at mean low water, from Moss Point to the anchorage in the bay, and to maintain the river above Moss Point in its improved condition.

The channel, before the improvement commenced, had a least depth of 3 feet. This was increased to 7½ feet with a width of 180 feet by dredging, from 1878 to 1880, at a cost of about \$45,000.

From the light-house near the mouth of the river throughout the entire length there is a navigable channel, obtained by the removal of snags and overhanging trees from 1881 to 1884, inclusive, at a cost of about \$15,000.

The amount expended to June 30, 1888, is \$23,117.70, and resulted in obtaining a channel by dredging through the bar at the mouth of the river with a minimum width of 135 feet and a maximum width of 205 feet and a minimum depth of 9.5 feet at mean low water.

The amount expended during the fiscal year ending June 30, 1889, is \$483.48, for examination of channel, etc. The officer in charge reports that it has been necessary to increase the estimate for completion of this work owing to the hardness of a portion of the material to be dredged.

The amount available and the appropriation asked for are to be expended in the further improvement of the channel, according to project, and in the removal of such obstructions in the river above Moss Point as have lodged during the suspension of work.

July 1, 1888, amount available.....	\$487.55
Amount appropriated by act of August 11, 1888.....	27,000.00
	<hr/> 27,487.55
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	483.48
July 1, 1889, balance available.....	<hr/> 27,004.07
{ Amount (estimated) required for completion of existing project.....	89,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	50,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix R 5.)	

6. *Harbor at Biloxi, Mississippi.*—The present project for the improvement of this harbor was adopted in 1882, the object being to afford a channel of entrance from Mississippi Sound to the wharves at Biloxi of navigable width and 8 feet deep; the channel before was 4½ feet deep at the shoalest part.

The amount expended to June 30, 1888, was \$17,153.41, and resulted in dredging a channel 8 feet deep throughout at mean low tide, and 126 feet wide from the 8-foot curve outside in Mississippi Sound, for a distance of 2,150 feet, thence 84 feet wide for a further distance of 2,000 feet, and thence 124 feet wide a further distance of 1,030 feet to the 8-foot curve in Biloxi Bay.

The amount expended during the fiscal year ending June 30, 1889, is \$298.78 in examination of channel, etc.

July 1, 1888, amount available.....	\$346.59
Amount appropriated by act of August 11, 1888.....	18,500.00
	<hr/> 18,846.59
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	298.78
July 1, 1889, balance available.....	<hr/> 18,547.81
{ Amount (estimated) required for completion of existing project.....	19,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	19,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix R 6.)	

7. *Pearl River, Mississippi, between Edinburgh and Carthage.*—The project for the improvement of this portion of the river was adopted in 1884, the object being to obtain a good high-water channel throughout for the use of steamers for six or eight months of the year. Before the improvement was commenced navigation was only possible during very high water, and was even then troublesome.

The amount expended up to the close of the fiscal year ending June 30, 1888, was \$4,695.63, and resulted in the improvement of the river from Edinburgh to Carthage, 24½ miles, so that boats of 3½ feet draught could navigate safely on a 5-foot rise above ordinary low water.

The amount expended during the fiscal year ending June 30, 1889, is \$560.79, and resulted in the full improvement of 6 miles of river from Edinburgh down, so that light-draught boats can navigate that portion on a 4½-foot rise above ordinary low water.

July 1, 1888, amount available.....	\$54.92
Amount appropriated by act of August 11, 1888.....	5,000.00
	<hr/> 5,054.92

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	560.79
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July 1, 1889, balance available.....	<hr/> 4,494.13
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{ Amounted (estimated) required for completion of existing project.....	5,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	5,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix R 7.)

8. *Pearl River, Mississippi, from Jackson to Carthage.*—The present project for the improvement of this portion of the river was adopted in 1880, the object being to obtain a channel of 5 feet depth and of navigable width throughout.

Before the improvement was commenced navigation, even during high water, was difficult on account of snags and overhanging trees.

The amount expended to June 30, 1888, was \$20,749.02, and resulted in such improvement of 62 miles of river from Carthage down that boats of 3 feet draught of water could navigate this distance on a 4-foot rise above ordinary low water.

The amount expended during the fiscal year ending June 30, 1889, is \$2,207.71, and resulted in the improvement of 89 miles of river from Carthage down, so that light-draught boats can navigate this distance with comparative safety on a 3-foot rise above ordinary low water.

July 1, 1888, amount available.....	\$0.96
Amount appropriated by act of August 11, 1888.....	2,500.00

2,500.96

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	2,207.71
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July 1, 1889, balance available.....	<hr/> 293.27
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{ Amount (estimated) required for completion of existing project.....	26,500.00
{ Amount that can profitably be expended in fiscal year ending June 30, 1891	5,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix R 8.)

9. *Pearl River, Mississippi, below Jackson.*—The present project for the improvement of this portion of the river was adopted in 1880, the object being to obtain a channel 5 feet deep at ordinary low water, and of navigable width from the mouth of the river up to Jackson.

Before the improvement the river was not navigable at all at low water, and difficult at high water.

The amount expended on the work to June 30, 1888, was \$92,115.45, and resulted in the complete improvement of that section of the river from the head of the cut-off near the head of West Pearl River down to the mouth at the Rigolets, a distance of 51 miles, and the partial improvement of the river from Jackson down to the cut-off, a distance of 26½ miles.

The amount expended during the fiscal year ending June 30, 1889, is \$7,239.51, and resulted in the thorough repair of the plant, in reworking part of Homes Bayou; in closing West Pearl or Old River with willows, and the partial improvement of 25 miles of river from the head of the cut-off to Pool's Bluff, so that light-draught boats can navigate a distance of 76 miles from the mouth up all the year round.

July 1, 1888, amount available	\$9.55
Amount appropriated by act of August 11, 1888	15,000.00
	<hr/> 15,009.55
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	7,239.51
	<hr/> 7,770.04
{ Amount (estimated) required for completion of existing project.....	55,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	30,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix R 9.)	

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examination of *Gulf Port Harbor, Mississippi*, was made by the local engineer in charge, Major Damrell, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers concurring in the conclusion reached in this instance, has given no instructions to make further survey with the view to its improvement. (See Appendix R 10.)

At the following localities, reported by the local engineer as worthy of improvement, and this conclusion being concurred in by the Chief of Engineers, the result of the preliminary examination containing information sufficient to indicate to Congress the probable cost of the work required, no further report or survey appeared to be necessary:

1. *Bluff Creek, Mississippi, from its mouth to the head of navigation.*—Estimated cost of improvement \$1,000, to be applied to removal of logs and other obstructions from channel, and the removal of leaning trees. (See Appendix R 11.)

2. *Leaf River, Mississippi, from its mouth to the mouth of Bowie Creek, near the New Orleans and Northeastern Railroad.*—The improvement proposed contemplates the removal of snags, logs, and gravel-bars at an estimated cost of \$25,000. (See Appendix R 12.)

3. *Chickasaw River, Mississippi, from its mouth to Enterprise.*—This river is considered worthy of improvement by the removal of logs, snags, and overhanging trees from its mouth up to railroad bridge near Shubuta, at an estimated cost of \$30,000. (See Appendix R 13.)

4. *Bayou Chitta [Bogue Chitto], Louisiana.*—Estimated cost of improvement \$55,000 (not including necessary changes to seven bridges crossing the stream), to be applied to securing a channel for steam boats by removal of snags, logs, overhanging trees, and fish-traps, and the closing of the west mouth. (See Appendix R 14.)

The required preliminary examinations of the following rivers have been made by Major Damrell, and they are considered worthy of improvement. The surveys provided for by the act have not been completed; the reports will be submitted when received:

1. *Sipsy River, Alabama, from the Tombigbee River at Vienna to Texas, with a view of easy transportation of coal.*

2. *Warrior River, Alabama, from Tuscaloosa to Demopolis, for deepening and widening the channel with a view of the easy transportation of coal.*

3. *Tombigbee River, Alabama and Mississippi, between Vienna and Cotton Gin, with a view of obtaining continuous navigation.*

INSPECTION OF THE IMPROVEMENT OF THE SOUTH PASS OF THE MISSISSIPPI RIVER.

Inspecting officer, Capt. W. L. Fisk, Corps of Engineers.

The inspecting officer in his annual report states that the principal work undertaken during the year is the renewal of the concrete capping of the east jetty.

The channel required by law has been maintained during the year except for eight days, when there was a deficiency between 8,000 and 10,000 feet below East Point, rendering dredging necessary.

The least depth during the year from river to sea was 27 feet, and the least width of the 26-foot channel was 210 feet.

At the head of South Pass the least depth during the year was 30.4 feet; this is the present depth and at no time has the width of the 30-foot channel been less than 490 feet.

Beyond the ends of the jetties the most direct 30-foot channel became barely closed in May in consequence of a slight shoaling, but the one turning to the eastward maintained during the year and has a depth of 33.8 feet, the 26 and 30 foot channels being 430 and 200 feet wide, respectively.

No vessels have had any trouble in the pass or jetties during the year.

Numerous violations of the rules regulating the navigation of South Pass were reported to the War Department during the year. The cases were taken into court, but as yet no decision has been rendered.

July 1, 1888, amount available.....	\$4. 41
Amount appropriated by act of August 11, 1888.....	10, 000. 00
	10, 004. 41
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	8, 962. 14
July 1, 1889, balance available	1, 042. 27
(See Appendix S.)	

IMPROVEMENT OF VARIOUS WATER-COURSES IN THE STATE OF LOUISIANA—IMPROVEMENT OF SABINE PASS AND OF SABINE AND NECHES RIVERS, TEXAS.

Officer in charge, Capt. W. L. Fisk, Corps of Engineers. Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. *Tchefuncte River and Bogue Falia, Louisiana.*—The river is navigable for steamers drawing 5 feet to Old Landing, about 10 or 12 miles above its mouth, and then for lighter-draught schooners to Covington, about 2 miles further up on the Bogue Falia. The bar at the mouth of the river had a depth of 4½ feet on it at the lowest stage of the water. The project for the improvement of the river was made in 1880, and contemplated the removal of overhanging trees, logs, etc., in channel, and the dredging of the bar at its mouth.

The obstructions, such as overhanging trees, logs in beds, etc., were removed, but the bar at the mouth was not dredged, as it would be likely to reform.

To prevent this, or retard its reformation, the officer in charge in 1884 recommended the building of a breakwater, extending into the lake for 2,500 feet, and then dredging a channel through the bar.

With the two appropriations of \$1,500 each, made in 1881 and 1882, the obstructions below Covington were removed. Part of the unexpended balance was used for the construction of the breakwater extending 820 feet into the lake.

The original estimated cost of improving the river was \$5,460, but this did not include building a breakwater across the bar.

The project, as modified in 1884, is estimated to cost \$20,400. This has not yet received the sanction of Congress.

At the close of the fiscal year ending June 30, 1885, \$3,000 had been expended on this improvement, at which time the navigation had been improved for schooners to Covington in consequence of removal of snags and overhanging trees, and it is thought that the breakwater has retarded the drift of sand on the bar at the river's mouth.

Twenty-five hundred dollars was appropriated by Congress in August, 1886, to improve Bogue Falia between Old Landing and Covington. Early in 1887 operations began, and channels were cut through the bars in this stretch of bayou 5 feet in depth and 30 to 60 feet wide, giving better navigation to schooners to and from Covington.

To carry out the project for making the mouth of the Tchefuncte a harbor of refuge, \$19,000 will be required.

Otherwise no money for the further improvement of this stream during the fiscal year ending June 30, 1891, is required.

July 1, 1888, amount available.....	\$127. 13
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	127. 13

(See Appendix T 1.)

2. *Tickfaw River and its tributaries, Louisiana.*—In 1879 Congress authorized an examination of this river. A project was submitted in 1881 to clean out the river and its navigable branches—the Natalbany, Blood, and Ponchatoula rivers—by removing logs, snags, trees, etc., at an estimated cost of \$10,230.

In 1881, 1882, 1886, and 1888 Congress made appropriations, aggregating \$7,000, and 20 miles of the Tickfaw and the Natalbany to Springfield, the head of navigation, have been improved. Work was also done on the Ponchatoula as far as it was thought advisable.

The Blood River was also cleaned out as far as navigable. Only a little wood and some saw-logs are carried or floated on this stream.

The improvement is not permanent, as obstructions will re-form in all these streams.

With the appropriation of 1886 the work was completed according to the original project, but obstructions having re-formed in the mean time, it was necessary to use the appropriation of 1888, \$1,000, for removing them. An annual appropriation of \$1,000 will keep these streams in good order.

July 1, 1888, amount available	\$170. 04
Amount appropriated by act of August 11, 1888.....	1, 000. 00
	<hr/>
	1, 170. 04
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	1, 151. 84
July 1, 1889, balance available	<hr/> 18. 20 <hr/>

{ Amount (estimated) required for completion of existing project.....	\$1,000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	1,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix T 2.)	

3. *Improvement of Amite River, Louisiana.*—Before improvement the river was obstructed by snags, sunken logs, and trees. One or two small steam-boats and a few sailing vessels were employed in the commerce of the river. In 1880 a project was made to remove obstructions above Bayou Manchac, so as to get 5 feet depth as far as appropriations would permit. Eight thousand dollars was appropriated, and the improvement of 40 miles of river above Bayou Manchac was contracted for. The work was of little benefit to commerce. In 1881 \$5,000 more was appropriated to continue the work. In 1883 the project was modified so as to improve the river below Bayou Manchac, and work was done upon about 8 miles of river.

In 1886 \$2,000 more was appropriated to continue the improvement. This was applied to that portion of the river below Bayou Manchac, and principally between there and Port Vincent. Work was resumed in November, 1886, and completed in January, 1887, and the channel cleared.

In 1888 \$5,000 was appropriated, of which \$2,500 was made applicable to Bayou Manchac by the terms of the act.

Under this appropriation Bayou Manchac was cleaned out from its mouth to Hereford Landing, a distance of 9½ miles, and the obstructions that had re-formed in Amite River below the mouth of Manchac were removed.

The improvement is not a permanent one, as new obstructions will form from the caving banks.

The estimated annual expense of keeping this stream clear is \$2,000. The original estimated cost of the work on Amite River only was \$23,760, of which \$17,500 has been appropriated, and there has also been appropriated for Bayou Manchac \$2,500.

July 1, 1888, amount available.....	\$333. 33
Amount appropriated by act of August 11, 1888.....	5,000. 00
	<hr/> 5,333. 33
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	4,709. 29
	<hr/> 624. 04

{ Amount (estimated) required for completion of existing project	3,760. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	3,800. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix T 3.)

4. *Bayou La Fourche, Louisiana.*—The natural channel was much obstructed by snags, overhanging trees, shoals, and wrecks. The original project, adopted in 1879, had for its object the removal of these obstructions.

The amount expended on this work up to the end of fiscal year ending June 30, 1884, was \$24,998.24.

The amount expended during fiscal year ending June 30, 1885, was \$3,756.21 for care of property, gauge-readings, and continuing improvement. Much relief has been given to commerce by removal of snags, etc.

The project adopted is that for the canalizing of the bayou, connecting it with the Mississippi by a lock at its head. This improvement is estimated as costing \$450,000, with \$31,000 annual expense of maintenance, this including \$22,500 interest on original cost of \$450,000 at 5 per cent.

In 1888 Congress appropriated \$50,000 for the improvement of Bayou La Fourche on the plan of Lieutenant Crosby, Corps of Engineers, dated June 11, 1886, and provided for dredging for the immediate relief of low-water navigation.

The money becoming available so late in the season, it was impossible to do all the dredging required to obtain 2 feet at low water between Donaldsonville and Thibodeaux, and therefore it was decided to remove only the bar at the head, hoping to let in enough water to relieve flat-boat navigation. This was done, and the flat boats which had been laid up a day or two at the time the cut was opened through immediately began running and continued until the river rose to a stage sufficient to admit the steam-boats.

This dredging cost \$3,184.85. Specifications were prepared, and the remainder of the work advertised, bids to be opened June 10, 1889.

The only bid received requiring double the money available to do the work it was rejected and authority granted to make arrangements to scour out the bars, using a stern-wheel steam-boat.

July 1, 1888, amount available.....	\$79.61
Amount appropriated by act of August 11, 1888	50,000.00
	<hr/> 50,079.61
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	3,236.70
	<hr/> 46,842.91
{ Amount (estimated) required for completion of existing project.....	450,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	100,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix T 4.)

5. *Bayou Terrebonne, Louisiana.*—This bayou was examined by direction of Congress in 1879. The estimated cost of the improvement was \$18,800, afterward increased to \$38,800, to consist of dredging a channel 4 feet deep, and clearing out all obstructions to Houma, La.

The total amount appropriated by Congress for this work is \$38,800.

When work was commenced in 1880, the Bayou Terrebonne, in many places, was but little more than a drainage ditch, being about 11 feet wide where the dredge commenced work. The first 7½ miles of dredging terminated about 15½ miles below Houma.

In 1882 work was resumed and continued to within about 10½ miles of Houma. In 1886 work was again resumed, and during the fiscal year 1886-'87 the channel was lengthened 4.1 miles. The dredge continuing work until December 17, 1887, carried the channel to the railroad depot at Houma and there dug a turning-basin, which completes the work according to the approved project and \$3,000 within the estimated cost.

In 1888 Congress appropriated \$3,000, which will be held until the bayou requires re-dredging.

July 1, 1888, amount available	\$519.67
Amount appropriated by act of August 11, 1888	3,000.00
	<hr/> 3,519.67
July 1, 1889, balance available.....	

(See Appendix T 5.)

6. *Bayou Plaquemine, Louisiana*.—This is a new work. To comply with the requirements of the river and harbor act of August 5, 1886, a preliminary examination and survey were made of the mouth of Plaquemine, with a view to its connection with the Mississippi River by locks, and also Bayou Plaquemine and other connecting streams to form the best route to Grand Lake, La. The report of the result of the survey is printed in Senate Ex. Doc. No. 21, Forty-ninth Congress, second session, and also as Appendix S 21, of the Report of the Chief of Engineers for 1887.

The proposed project provides for the opening of the water-route indicated by removal of snags and dredging and constructing a lock at the mouth of Bayou Plaquemine, at an estimated cost of \$1,708,250.

The river and harbor act of August 11, 1888, appropriates \$100,000 for this work, and a further sum of \$200,000 may be profitably expended in continuing it during the fiscal year ending June 30, 1891.

By the terms of the above act the \$100,000 appropriated was to secure the mouth of the bayou from further caving and to dredge a channel 60 feet wide and 6 feet deep from deep water up to Plaquemine Dike.

On the recommendation of the officer in charge the first part of this work was transferred to the officer in charge of the fourth district of the Mississippi River, who has plant available for this work, thus avoiding the expense of building it. The other portion of the work was commenced early in June by the Government dredge that had been working at the mouth of Neches River, Texas, during the winter and spring, and is progressing satisfactorily.

Amount appropriated by act of August 11, 1888.....	\$100,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	3,685.80
July 1, 1889, balance available.....	96,314.20

Amount (estimated) required for completion of existing project.....	1,608,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1891.....	200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix T 6.)

7. *Bayou Courtableau, Louisiana*.—An examination was made of this stream in 1879. The estimated cost of improving it below Port Barre was \$40,000.

In June, 1880, Congress appropriated \$7,500 to commence work, the project being to close some of the bayous that at high water ran from the Courtableau, and thus force all the water flowing out of the bayou over the Little Devil Bar at its mouth.

After this bar was removed, locks and dams were to be constructed so as to give slackwater navigation to Washington, La. In 1883 this estimate was increased to \$78,500, and provided for a masonry instead of a timber lock.

In 1882 one dam was built on the Big Fordoche, another in the Little Fordoche, and trees were slashed on some of the smaller bayous, with a view to checking the flow of water through them. The effect was to increase the depth of water over Little Devil Bar.

In 1884 one of the dams was cut, and Little Devil Bar reformed. In 1885 this dam was rebuilt and the other dam which was damaged was repaired.

In 1886 these two dams were again repaired and another was nearly completed in Bayou English.

A sudden rise in the Atchafalaya prevented the work from being continued and a portion of the last was destroyed.

During the fiscal year 1887-'88 the Bayou English dam was repaired and completed, Bayou Mamzelle was closed, and the wings of the dam closing the Big Fardoche were repaired. At the time work ceased, early in November, the bar was cutting out rapidly, there being then a channel of 3 to 5 feet, while when work begun there was one of but a few inches. However, at that time the closure of Old River prevented any communication with the Mississippi River. In August, 1888, Congress appropriated \$5,000 for the continuance of this work. An examination made in October at low water showed that the water had cut around one end of each dam. The plant was at once put in order and material obtained to repair the old dams, and build others, closing as many of the other run outs as possible with the funds in hand. An early beginning of high-water season made it necessary to wait for the next low water, and work will be commenced as soon as the water will permit.

The estimate for closing the bayous is \$2,107.90.

July 1, 1888, amount available.....	\$330. 87
Amount appropriated by act of August 11, 1888.....	5, 000. 00
	<hr/>
	5, 330. 87
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	694. 26
	<hr/>
July 1, 1889, balance available.....	4, 636. 61
	<hr/>
{ Amount (estimated) required for completion of existing project.....	2, 107. 90
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	2, 200. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix T 7.)

8. *Calcasieu River and Pass, Louisiana.*—In 1874, and again in 1882-'83, dredged channels were cut through the flats in Calcasieu Lake above Calcasieu Pass.

The dredged channel was 8 feet deep and 70 feet wide by 7,500 feet long.

In 1885 this channel had again shoaled to a depth of 3½ feet and needed redredging, but an unfortunate wording of the appropriation, "Improving Calcasieu River," prevented its application to this work. In 1886 this was remedied, and funds heretofore appropriated for Calcasieu River became available for both the pass and the river. Contracts were made in 1886 for building two lines of piles and planking about 120 feet apart and a mile or more in length, between which a channel 100 feet in width and 6 feet in depth was to be dredged, and the excavated material thrown outside of the lines of the piles.

The excavation of a channel 100 feet wide and 6 feet deep through a bar at the junction of the river and lake was included in the contracts.

Work was commenced on the lines of piles and planking in the winter of 1886. In the spring of 1887 operations were resumed and the pile-work and planking partially completed, when the contract was annulled January 3, 1888.

During this long delay the revetment was badly damaged by the teredo. The project was modified so far as to omit the revetment.

Work was begun in March and completed August 31, 1888.

The results will not be permanent.

July 1, 1888, amount available.....	\$6,236.72
Amount appropriated by act of August 11, 1888.....	10,000.00
	<hr/> 16,236.72
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	6,236.72
	<hr/> 10,000.00
July 1, 1889, balance available	
(See Appendix T 8.)	

9. *Sabine River, Louisiana and Texas.*—At the commencement of the improvement of the river there was a depth of $3\frac{1}{2}$ feet on the bar at its mouth and also above the town of Orange. Logs, snags, etc., above here interfered with navigation.

In 1880 a channel 6 feet deep, 70 to 100 feet wide, was dredged through the bar. In 1881 several small cuts to avoid bends obstructed with logs were made above Orange.

The dredged channel over the bar is somewhat obstructed by logs, but the depth is sufficient for present demands of navigation and commerce.

An examination above Orange in May last showed many snags in parts of channel, and a project was prepared for the expenditure of the remaining balance.

July 1, 1888, amount available.....	\$4,546.56
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	24.90
	<hr/> 4,521.66
July 1, 1889, balance available	
{ Amount (estimated) required for completion of existing project.....	4,521.66
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix T 9.)	

10. *Neches River, Texas.*—Before this river was improved the bar at its mouth had only 3 feet of water over it, and snags and fallen trees obstructed navigation between Yellow Bluff and Bevilspport.

In 1880 a channel was dredged through the bar at the mouth of the river 5 feet deep and 30 to 60 feet in width. In 1882 the river between Yellow Bluff and Bevilspport was cleared of obstructions. A little less than \$21,000 had been expended on these improvements prior to June 30, 1884.

The bar at the mouth had again shoaled, so that at extreme low water there was only a navigable depth of about 3 feet. The channel was dredged to a depth of 5 feet by the Government dredge, which had been at work at Calcasieu Pass, and the work was completed in May last.

The improvement will not be permanent, as the bar will reform.

No appropriation is required for fiscal year ending June 30, 1891.

July 1, 1888, amount available	\$11,667.84
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	7,500.00
	<hr/> 4,167.84
July 1, 1889, balance available	
(See Appendix T 10.)	

11. *Sabine Pass, Texas.*—The object of this improvement is to obtain deep water at this locality so as to give an outlet to the products of eastern Texas and western Louisiana, and give a good harbor in the Gulf coast.

Dredging was done here in 1878 and 1880, but the excavated channels re-filled. In 1880 a project was made to get deep water by means of two jetties of brush and stone, and to dredge between them if found necessary, the estimated total cost of the work being \$3,177,606.50.

The following appropriations were made: August, 1882, \$150,000; July, 1884, \$200,000; August, 1886, \$198,750; August, 1888, \$250,000.

Work was commenced in 1883, and has continued since, when funds were available.

The west jetty was built out continuously from the shore to a length of a little more than 3 miles, but was only completed to mean high-tide level for a length of 7,270 feet.

The greater part of the foundation course of the outer mile of this jetty has since been destroyed by the sea, in the absence of funds to properly protect it against damage. The east jetty foundation course is now 16,647 feet in length, measured from the shore end, and is practically completed up to low-water level for 16,400 feet of this length.

During the past year the foundation of the east jetty has been extended about 2,300 feet; of this a little over 2,000 feet has been built up to about mean low tide and 1,700 feet old work brought up to about 1 foot above mean high tide. Of the remaining 300 feet 200 feet will be built up entirely of rubble-stone, faced with blocks weighing from one to three tons each.

About 3,100 feet of the west jetty has been raised to one-half foot above mean high tide.

With the money on hand it is expected to bring all of the east jetty and about 7,500 feet of the west jetty to 1 foot above high water.

The assistant engineer in local charge reports having sounded across the bar and found a least depth of 10.5 feet, mean low tide.

When the jetties were begun there was 6 to 6½ feet on the bar.

July 1, 1888, amount available.....	\$1,804.33
Amount appropriated by act of August 11, 1888	250,000.00

251,804.33

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$115,633.05
July 1, 1889, outstanding liabilities.....	43,017.61
July 1, 1889, amount covered by existing contracts	72,665.35

231,316.01

July 1, 1889, balance available	20,488.22
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{ Amount (estimated) required for completion of existing project.....	1,801,250.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1889	500,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix T 11.)

12. *Removing sunken vessels or craft obstructing or endangering navigation.*—In March, 1888, the French ship *Ile Marthe* toppled over while in the Vallette Dry-Dock, at Algiers, La., and sank, carrying with it the entire dock. Under section 4 of the river and harbor act of June 14, 1880, after duly publishing notice to owners, the masts, bowsprit, and rigging of the ship were removed under agreement with Mr. E. A. Burris, the work being completed in March, 1889.

(See Appendix T 12.)

EXAMINATIONS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS
OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examinations of the following localities were made by the local engineer in charge, Captain Fisk, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers concurring in the conclusions reached in these instances, has given no instructions to make further survey with the view to their improvement:

1. *Bayou St. John from the head of navigation to Lake Pontchartrain, Louisiana.*—(See Appendix T 13.)

2. *Bayou Terrebonne, for continuing dredging three miles above Houma, Louisiana.*—(See Appendix T 14.)

3. *Bayou Terrebonne and Bayou Black, Louisiana, with the view of opening a shorter water way between Mississippi River and Berwick's Bay, Texas and Mexico.*—(See Appendix T 15.)

4. *Atchafalaya River, Louisiana, from Berwick's Bay to Gulf of Mexico, to secure a channel of 20 feet depth.*—(See Appendix T 16.)

5. *Harbor of Baton Rouge, Louisiana.*—(See Appendix T 17.)

6. *Bayou des Glaizes, Louisiana.*—(See Appendix T 18.)

7. *Bayou Manchac, Louisiana.*—In the opinion of the local engineer and of the Chief of Engineers, this stream is not worthy of improvement as a water route from the Mississippi River to Mississippi Sound, which is understood to be the object contemplated by the act.—(See Appendix T 19.)

8. *Bayou Teche, Louisiana, with a view to putting in locks.*—(See Appendix T 20.)

At the following localities, reported by the local engineer as worthy of improvement to a limited extent, this conclusion being concurred in by the Chief of Engineers, and the result of the preliminary examination containing information sufficient to indicate to Congress the probable cost of the work required, no further survey appeared to be necessary:

1. *Tangipahoa River, Louisiana.*—Estimated cost, \$5,000, to be expended in snagging to clear out the stream.—(See Appendix T 21.)

2. *Mouth and passes of Calcasieu River, Louisiana.*—Estimated cost, \$600,000, to be applied in obtaining a channel 12 feet deep.—(See Appendix T 22.)

3. *Amite River, Louisiana.*—Estimated cost of improving the stream to a point 5 miles above the mouth of Bayou Manchac, \$5,000.—(See Appendix T 23.)

4. *Tchefuncte River and Bogue Falia [Falaya], Louisiana.*—Considered worthy of improvement only to the extent of removing snags, at an estimated annual expense of \$1,000.—(See Appendix T 24.)

5. *Tickfaw River, Louisiana.*—Considered worthy of improvement only to the extent contemplated in existing project.—(See Appendix T 25.)

6. *Bayou La Fourche, Louisiana, from Donaldsonville to the Gulf.*—Considered worthy of improvement only to the extent contemplated in existing project.—(See Appendixes T 26 and T 4.)

7. *Bayou Teche, Louisiana, from mouth to St. Martinsville.*—The improvement proposed is to thoroughly clear out the obstructions, consisting of snags, fallen trees, and sunken logs, at an estimated expense of \$7,500. When this is done an annual appropriation of \$1,000 will probably keep the stream in good condition.—(See Appendix T 27.)

SECURING MOUTH OF BAYOU PLAQUEMINE, LOUISIANA, FROM FURTHER CAVING.

Officer in charge, Capt. Dan O. Kingman, Corps of Engineers; Division Engineer, Col. O. B. Comstock, Corps of Engineers.

The river and harbor act of August 11, 1888, in making an appropriation for improving Bayou Plaquemine, Louisiana, provides for securing the mouth of the bayou from further caving, and an allotment of \$75,000 was made for this purpose and the work assigned to the charge of Capt. Dan O. Kingman, Corps of Engineers, he having under his direction, in connection with the work of the Mississippi River Commission, a suitable plant for the operations proposed.

A project for the application of the funds is under consideration.

A money statement will be found attached to report on improvement of Bayou Plaquemine, Louisiana, page 198.

(See Appendix U.)

IMPROVEMENT OF RIVERS AND HARBORS IN THE STATE OF TEXAS.

Officer in charge, Maj. O. H. Ernst, Corps of Engineers, having under his immediate orders until August 23, 1888, First Lieut. George A. Zinn, Corps of Engineers, and since September 27, 1888, First Lieut. William C. Langfitt, Corps of Engineers. Division Engineer, Col. O. B. Comstock, Corps of Engineers.

1. *Entrance to Galveston Harbor, Texas.*—The present project for the improvement of this locality was adopted in 1874, modified in 1880, and again modified in 1886, the object being to deepen the channel so as to admit sea-going vessels of the deepest draught. The natural depth upon the outer bar was about 12 feet at mean low tide, and upon the inner bar about 13 feet. The total amount expended to June 30, 1888, including \$100,000 subscribed in 1883 by the city of Galveston, was \$1,825,278.83. The amount expended during the year is \$241,897.44. It has resulted in deepening the channel over the outer bar to about 13½ feet, and that over the inner bar to about 21 feet. It is proposed during the coming year to extend the finished work of the south jetty seaward about 1 mile. During the fiscal year ending June 30, 1891, it is proposed to complete the south jetty now under construction to the crest of the bar and to begin the construction of a north jetty.

July 1, 1888, amount available.....	\$2, 871. 13
Amount appropriated by act of August 11, 1888.....	500, 000. 00
	<hr/> 502, 871. 13
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$183. 310. 96
July 1, 1889, outstanding liabilities.....	8, 736. 44
July 1, 1889, amount covered by existing contracts.....	272, 060. 27
	<hr/> 464, 107. 67
July 1, 1889, balance available.....	<hr/> 38, 763. 46
{ Amount (estimated) required for completion of existing project.....	6, 200, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891.....	1, 000, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix V 1.)

2. *Ship-channel in Galveston Bay, Texas.*—The present project for this improvement was adopted in 1871 and modified in 1877, the object be-

ing to excavate and maintain a channel 12 feet deep and 100 feet wide at bottom through Galveston Bay from Bolivar Channel to Morgan's Cut, a distance of about 18.9 miles. The average natural depth of the bay was about $8\frac{1}{2}$ feet, with a depth in some places of about 7 feet. The total amount expended to June 30, 1888, was \$325,022.30. The amount expended during the year was \$163,921.94. It has resulted in the excavation of a channel having an average depth of $14\frac{1}{2}$ feet through Redfish Bar, a length of about 2 miles, which, with some fluctuations, has been maintained since 1883, and more recently in the excavation of a channel not less than 12 feet deep and 100 feet wide for a length of about 10 miles from Bolivar Channel to Redfish Bar, and for a length of about 7 miles immediately north of Redfish Bar. The portion between Bolivar Channel and Redfish Bar having been completed about a year ago has shoaled to an average depth of about 11.61 feet and width of about 100 feet. Further shoaling will doubtless occur throughout the channel before further appropriations are made.

The work is not capable of permanent completion. It is estimated that an annual expenditure of about \$80,000 will be required to maintain it.

The work of improvement of ship-channel in Galveston Bay having reached the point in the bay at which the southern extremity of Morgan's Cut is located, the officer in charge, under instructions from this office, called upon the Buffalo Bayou Ship-Channel Company to execute its agreement of January 22, 1881, * to transfer to the United States its works at Morgan's Point.

Major Ernst, under date of the 19th September, 1889, transmits to this office the correspondence on the subject between himself and the president of the company, copies of which are herewith submitted, from which it will be seen that the company claims compensation for its property.

July 1, 1888, amount available.....	\$7, 278. 70
Amount appropriated by act of August 11, 1888	100, 000. 00
	<hr/> 107, 278. 70

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$48, 696. 27
July 1, 1889, outstanding liabilities.....	1, 046. 67
July 1, 1889, amount covered by existing contracts.....	49, 905. 71
	<hr/> 99, 638. 65

July 1, 1889, balance available.....	7, 640. 05
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{ Amount that can be profitably expended in fiscal year ending June 30, 1891	100, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix V 2.)

3. *Trinity River, Texas.*—The present project for the improvement of this stream was adopted in 1873, and modified in 1889, the object being to afford a navigable channel 6 feet deep through the bar at the mouth. The natural channel is narrow and has a depth of but 3 feet 2 inches. The total amount expended to June 30, 1888, was \$34,500. The amount expended during the fiscal year was \$35.97. It has resulted in facilitating the entrance to the river, though the depth over the bar has not been increased. It is proposed during the coming year to strengthen and extend the revetment of the west side of the channel so that it shall constitute the beginning of a timber jetty, and during the fiscal

* See Annual Report Chief of Engineers for 1881, Part II, page 1338.

The amount expended during the fiscal year ending June 30, 1889, is \$7,239.51, and resulted in the thorough repair of the plant, in reworking part of Homes Bayou; in closing West Pearl or Old River with willows, and the partial improvement of 25 miles of river from the head of the cut-off to Pool's Bluff, so that light-draught boats can navigate a distance of 76 miles from the mouth up all the year round.

July 1, 1888, amount available	\$9. 55
Amount appropriated by act of August 11, 1888	15, 000. 00
	<hr/> 15, 009. 55
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	7, 239. 51
	<hr/> 7, 770. 04
{ Amount (estimated) required for completion of existing project	55, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	30, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix R 9.)	

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examination of *Gulf Port Harbor, Mississippi*, was made by the local engineer in charge, Major Damrell, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers concurring in the conclusion reached in this instance, has given no instructions to make further survey with the view to its improvement. (See Appendix R 10.)

At the following localities, reported by the local engineer as worthy of improvement, and this conclusion being concurred in by the Chief of Engineers, the result of the preliminary examination containing information sufficient to indicate to Congress the probable cost of the work required, no further report or survey appeared to be necessary:

1. *Bluff Creek, Mississippi, from its mouth to the head of navigation.*—Estimated cost of improvement \$1,000, to be applied to removal of logs and other obstructions from channel, and the removal of leaning trees. (See Appendix R 11.)

2. *Leaf River, Mississippi, from its mouth to the mouth of Bowie Creek, near the New Orleans and Northeastern Railroad.*—The improvement proposed contemplates the removal of snags, logs, and gravel-bars at an estimated cost of \$25,000. (See Appendix R 12.)

3. *Chickasaw River, Mississippi, from its mouth to Enterprise.*—This river is considered worthy of improvement by the removal of logs, snags, and overhanging trees from its mouth up to railroad bridge near Shubuta, at an estimated cost of \$30,000. (See Appendix R 13.)

4. *Bayou Chitta [Bogue Chitto], Louisiana.*—Estimated cost of improvement \$55,000 (not including necessary changes to seven bridges crossing the stream), to be applied to securing a channel for steam-boats by removal of snags, logs, overhanging trees, and fish-traps, and the closing of the west mouth. (See Appendix R 14.)

The required preliminary examinations of the following rivers have been made by Major Damrell, and they are considered worthy of improvement. The surveys provided for by the act have not been completed; the reports will be submitted when received:

1. *Sipsey River, Alabama, from the Tombigbee River at Vienna to Texas, with a view of easy transportation of coal.*

about 260 feet per year, and the channel depth over the bar varied from 7 feet to 9½ feet. The total amount expended to June 30, 1888, including \$9,938.93 subscribed in 1883 by citizens of Rockport and Corpus Christi, was \$489,006.73. The amount expended during the year was \$57,862.61. It has resulted in fixing the position of the pass. It is proposed during the fiscal year ending June 30, 1891, with the sum here estimated, to begin the reconstruction of the south jetty.

July 1, 1888, amount available.....	\$2,182.20
Amount appropriated by act of August 11, 1888.....	100,000.00
	<hr/> 102,182.20

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$57,231.11
July 1, 1889, outstanding liabilities.....	631.50
	<hr/> 57,862.61

July 1, 1889, balance available.....	<hr/> 44,319.59
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{ Amount (estimated) required for completion of existing project.....	1,471,293.72
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	300,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix V 7.)

8. *Harbor at Brazos Santiago, Texas.*—The present project for the improvement of this locality was adopted in 1881, the object being to fix the position of the channel over the bar at the entrance and to deepen it. In its natural state the channel was shifting, and its depth varied from 6 feet to 8 feet. The total amount expended to June 30, 1888, was \$183,590.23 (besides an appropriation of \$6,000 in 1878 applied to removing a wreck). It has resulted in no useful effect upon the bar, and the works heretofore constructed have practically disappeared. The amount expended during the year was \$60. It was applied to keeping a record of commercial statistics. The officer in charge considers that \$600,000 is the least amount which should be available before beginning the construction of jetties. He suggests that if the importance of the port be not considered sufficient to justify so large an appropriation the improvement be deferred for the present. The amount required for the entire completion of the project is \$1,071,000.

July 1, 1888, amount available.....	\$33,909.77
Amount appropriated by the act of August 11, 1888.....	25,000.00
	<hr/> 58,909.77

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$55.00
July 1, 1889, outstanding liabilities.....	5.00
	<hr/> 60.00

July 1, 1889, balance available.....	<hr/> 58,849.77
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{ Amount (estimated) required for completion of existing project.....	1,071,000.23
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix V 8.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examinations of the following localities were made by the local engineer in charge, Major Ernst, and reported by him as not worthy of improvement, with facts and reasons for such

opinion. The Chief of Engineers, concurring in the conclusions reached in these instances, has given no instructions to make further survey with the view to their improvement.

1. *Rio Grande River, New Mexico, from Embudo to El Paso, Texas.*—(See Appendix V 9.)

2. *For removal of raft on Guadalupe River, Texas.*—(See Appendix V 10.)

3. *Mouth of Caney Creek, where it empties in Matagorda Bay, Texas.*—(See Appendix V 11.)

It appearing from the report of the preliminary examination made by the local engineer for *removal of bar at mouth of Cedar Bayou, where it empties into Galveston Bay, Texas*, that the locality is worthy of improvement, and the public necessity therefor being apparent from the facts and reasons reported, which are concurred in by the Chief of Engineers, Major Ernst was charged with its survey, the results of which will be submitted when received.

WESTERN RIVERS.

IMPROVEMENT OF RED RIVER, AND OF CERTAIN RIVERS IN THE STATES OF ARKANSAS AND TEXAS, AND OF CERTAIN RIVERS IN THE STATES OF LOUISIANA, MISSISSIPPI, AND TENNESSEE, TRIBUTARY TO THE MISSISSIPPI—WATER GAUGES ON THE MISSISSIPPI AND ITS PRINCIPAL TRIBUTARIES.

Officer in charge, Capt. J. H. Williard, Corps of Engineers. Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. *Red River, Louisiana and Arkansas.*—The present improvement was begun in 1872. At that time navigation above Shreveport, La., was almost impossible on account of the great raft. Low-water navigation between Shreveport and Grand Ecore, La., was affected seriously by the gradual enlargement of Tone's Bayou outlet, which depleted the main channel of the river below. The entire river from Fulton, Ark., to its mouth was greatly obstructed by snags, sunken logs, wrecks, leaning trees, etc., and the channel at the falls at Alexandria, La., was insufficient for the demands of commerce.

The project has contemplated the removal of the great raft, the closure of Tone's Bayou, the removal of snags and other obstructions, opening a channel through the falls at Alexandria, increasing the depth of channel at shoal places, and improving Alexandria Harbor.

The work from 1872 to the end of the fiscal year 1888 consisted of the removal of the raft, preventing its reforming, and clearing the river of obstructions. The excavation at the falls of Alexandria was practically completed. The work for the protection of Alexandria Harbor was completed according to the project as far as the funds available would permit. This, in connection with the dam at the lower falls, has been of some benefit to the river bank at Alexandria. The amount expended to June 30, 1888, was \$800,158.17.

In the past year snag-boat operations have been continued when the stages of water would allow advantageous work. The river has been at a good boating stage the greater portion of the time, and this, coupled with the work performed, has rendered navigation good and comparatively safe, except for a period of less than six weeks. As soon as the water reaches a low stage a large amount of work will be needed, as the banks will cave and slide as the river falls, and the snags and stumps in the channel will become dangerous to navigation.

The act of August 11, 1888, provided for continuing work in Cypress Bayou and the lakes between Shreveport, La., and Jefferson, Tex., and in Bayou Dorcheat (tributaries of Red River), by allotments of \$5,000 for each of these water-ways from the appropriation for this river. Heretofore, these have been provided for under separate heads of appropriation. Twelve-Mile Bayou, on the Cypress Bayou route, was cleared of obstructions in May, and the remaining work under the project for this stream, *i. e.*, the removal of stumps from the channel through Sodo and Fairy lakes and a small amount of dredging, will be done as soon as practicable. Work in the Dorcheat line, begun in May, was still in progress at the end of the year, but probably will be finished in August.

Survey of Red River.—This was begun in 1886 and continued until March, 1887, when the available funds were exhausted, the field work having been carried from Fulton, Ark., to Caspiana Landing, La., 44 miles below Shreveport. Operations were resumed in February, 1889, and a precise level line has been run, along the railroad, from the Coast and Geodetic Survey bench at Delta to Shreveport, La., connecting the survey with that of the Mississippi; the survey from Fulton, Ark., to Shreveport has been gone over and permanent bench-marks and triangulation monuments set. From Shreveport precise levels and tertiary triangulation have been carried down-stream for 62½ miles. This work will be continued to the mouth, placing benches and monuments at points selected for secondary triangulation, making a close topographic and hydrographic survey on the way. The survey will then be completed by secondary triangulation from the Atchafalaya River to Fulton, Ark., connecting with the Coast Survey and Mississippi River system.

July 1, 1888, amount available.....	\$1,841.83
Amount appropriated by act of August 11, 1888.....	100,000.00
	<hr/> 101,841.83
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$38,948.95
July 1, 1889, outstanding liabilities.....	125.80
	<hr/> 39,074.75
July 1, 1889, balance available.....	62,767.08

{ Amount that can be profitably expended in fiscal year ending June 30, 1891 100,000.00
 { Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix W 1.)

2. *Cypress Bayou, Texas and Louisiana.*—This improvement includes the whole navigable channel from Shreveport, La., to Jefferson, Tex., via Twelve-Mile Bayou, Sodo and Fairy lakes, and Cypress Bayou.

The first project consisted in cutting and dredging a high-water channel from Jefferson to Red River, which was completed in 1880, at a cost of \$94,000.

The act of August 5, 1886, appropriated \$18,000 "to complete the improvement." The project for application of this amount contemplated rebuilding the dredge formerly used on this work, and by means of this boat to straighten and mark the present channel, remove stumps therefrom, and reopen cuts by dredging.

The amount expended upon the latter project to June 30, 1888, was \$17,661.71, with which the dredge was rebuilt and the work in Cypress Bayou proper, which included the principal amount of dredging, com-

pleted. That remaining to be done was straightening and clearing the channel of stumps through the lakes to Shreveport at a cost of \$7,500.

The act of August 11, 1888, provided \$5,000 for continuing this work from the amount appropriated for "improving Red River, Louisiana and Arkansas," and the work is reported under this head.

The balance available July 1, 1888, has been expended in connection with this allotment.

July 1, 1888, amount available	\$338.29
July 1, 1889, amount expended during fiscal year	338.29

(See Appendix W 2.)

3. *Ouachita and Black Rivers, Arkansas and Louisiana.*—The improvement of Ouachita River was begun in 1871. Black River, the connecting stream between Ouachita and Red rivers, was added under the same head of appropriation by the act of 1884. The present project contemplates the removal of wrecks, logs, snags, leaning trees, etc., obstructing navigation, and the improvement of shoal places between Camden, Ark., and the mouth of the Black River. The original project contemplated improvement by a system of locks and dams, but was abandoned in 1874 on account of its cost and doubtful utility.

The amount expended under present project to June 30, 1888, was \$193,912.13. Besides the removal of obstructions, an increased depth of from 12 inches to over 3 feet was gained at some of the shoal places.

Resumption of operations in these streams was delayed by various causes, and nothing has been done for their improvement during the fiscal year. A light snag-boat was purchased and fitted up with machinery, etc., at a cost of \$3,432.21, under provision of the act of August 11, 1888, and \$732.82 has been expended for outfit of snag-boats. It is proposed to expend the available balance in operating the snag-boats during low water this summer and fall.

No estimate for permanent improvement can be submitted, as obstructions are forming continually.

Amount appropriated by act of August 11, 1888	\$20,000.00
July 1, 1889, amount expended during fiscal year	4,165.03

July 1, 1889, balance available	15,834.97
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{ Amount that can be profitably expended in fiscal year ending June 30, 1891	20,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867	

(See Appendix W 3.)

4. *Ouachita River, Arkansas, above Camden.*—This is a new work. The project, based on examination made in 1887, contemplates removing snags, cutting leaning timber, and building brush dams at the shoals between Camden and Arkadelphia, Ark., at an estimated cost of \$9,000.

The river and harbor act of August 11, 1888, appropriated \$9,000 to complete the work, which will be applied to carrying out the project during the low-water season this summer and autumn.

Amount appropriated by act of August 11, 1888	\$9,000
July 1, 1889, balance available	9,000

(See Appendix W 4.)

5. *Bayou d'Arbonne, Louisiana.*—The project for this improvement was adopted in 1884, and contemplates the removal of snags, logs, wrecks, leaning trees, etc., obstructing navigation from Stein's Bluff to the mouth, 42½ miles, at an estimated cost of \$15,000.

The amount expended to June 30, 1888, was \$7,000, which resulted in the removal of obstructions from about one-half of that part of the stream in which improvement is contemplated.

In the past fiscal year operations were not commenced until June 18, after which date a light snag-boat and chopping party were employed in removing obstructions, paying especial attention to the upper part, in which no work had been done before. It is probable that the available balance will be expended by August 1.

The work is not permanent, as new obstructions are forming continually.

Amount appropriated by act of August 11, 1888.....	\$2, 000. 00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	1, 000. 00
July 1, 1889, balance available	1, 000. 00
<hr/>	
{ Amount (estimated) required for completion of existing project	6, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	4, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix W 5.)

6. *Little River, Louisiana.*—This is a new work. The project is based upon an examination made in 1887, which contemplated the improvement of the portion of the stream between Catahoula Lake and Black River by the removal of sunken logs and leaning timber, at an estimated cost of \$2,500.

The act of August 11, 1888, appropriated \$2,500 for this purpose.

A light snag-boat and chopping party were employed in removing the obstructions from May 23 to June 13, when operations were suspended by high water. The available balance will be applied to completing the project during extreme low water.

Amount appropriated by act of August 11, 1888.....	\$2, 500. 00
July 1, 1889, amount expended during fiscal year.....	\$1, 701. 60
July 1, 1889, outstanding liabilities.....	6. 67
	<hr/>
	1, 708. 27

July 1, 1889, balance available	791. 73
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(See Appendix W 6.)

7. *Bayou Bartholomew, Louisiana and Arkansas.*—This improvement was begun, in 1881, the project contemplating the removal of wrecks, snags, overhanging timber, etc., obstructing navigation between Baxter, Ark., and the mouth, a distance estimated to be 213 miles.

The amount expended to June 30, 1888, was \$23,000. The work had extended nearly over the entire portion of the bayou included in the project and lessened the dangers of navigation. Before the improvement commenced three months was the average duration of the navigable season. Now it lasts six months and boats make trips in about one-third less time. Freight rates have been reduced about 33½ per cent.

Nothing was done during the fiscal year, but it is intended to employ the snag-boat and party working in Bayou D'Arbonne at the close of the year on this improvement as soon as practicable.

Permanent improvement can not be secured, as new obstructions are forming continually.

Amount appropriated by act of August 11, 1888.....	\$5, 000. 00
July 1, 1889, balance available	5, 000. 00

{ Amount that can be profitably expended in fiscal year ending June 30, 1891 \$5,000.00
 { Submitted in compliance with requirements of sections 2 of river and
 { harbor acts of 1866 and 1867.

(See Appendix W 7.)

8. *Bayou Boeuf, Louisiana.*—The project for improvement of this bayou was adopted in 1881, and contemplated the removal of snags, logs, leaning timber, etc., obstructing navigation between Wallace's Landing and its mouth, a distance of 280 miles. An examination of three outlets of the bayou near Point Jefferson, La., was made in 1884, and their closure recommended at a cost of \$8,500.

The amount of expenditures and outstanding liabilities to June 30, 1888, was \$18,482.75. The removal of obstructions enabled boats to run to Point Jefferson, 19 miles below Wallace's, during high-water. Outlet No. 1 was closed.

During the fiscal year 1888-'89 outlets Nos. 2 and 3 were closed, and the sand bar at Point Jefferson is washing away rapidly. Had the Outlets remained open the water ultimately would have left the main channel and navigation in Bayou Boeuf would have been destroyed. A chopping party and light snag-boat were employed in removing obstructions from Point Jefferson to the mouth, putting the bayou in fair navigable condition for the present.

It is proposed to apply the available balance to continuing this work. No permanent improvement can be secured, as new obstructions are added from time to time. The appropriation herein asked for can be expended profitably in clearing the banks of timber, building brush wing-dams to scour the bars, and removing shore-slides and logs and snags from the channel.

July 1, 1888, amount available.....	\$197.25
Amount appropriated by act of August 11, 1888	6,000.00
	<hr/> 6,197.25
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	5,219.73
July 1, 1889, balance available.....	<hr/> 977.52

{ Amount that can be profitably expended in fiscal year ending June 30, 1891 7,500.00
 { Submitted in compliance with requirements of sections 2 of river and
 { harbor acts of 1866 and 1867.

(See Appendix W 8.)

9. *Tensas River and Bayou Macon, Louisiana.*—The project for improvement of Tensas River was adopted in 1881, and contemplated the removal of logs, snags, leaning timber, etc., obstructing navigation from Dallas to its mouth, about 180 miles, at an estimated cost of \$23,000. Bayou Macon, a tributary, was added under the same head of appropriation by act of 1884, and the project contemplates the removal of the same class of obstructions as in Tensas from Floyd to its mouth, about 130 miles, at an estimated cost of \$17,000.

The amount expended to June 30, 1888, was \$11,000, \$7,000 of which had been applied to improvement of Tensas River and the balance to Bayou Macon.

During the fiscal year a light snag-boat and chopping party were employed in Bayou Macon February 1 to April 14, and in Tensas River April 15 to 22. Work in the former extended from Floyd to its mouth; in the latter it was confined to a stretch about 25 miles in length. Steamboat men speak well of the results, the master of the largest boat running in these streams stating that the run from mouth of Ma-

con to Floyd and return has been shortened 12 hours. The amounts expended were, \$4,343.99 in Bayou Macon and \$425 in Tensas River.

The work is not permanent, as new obstructions are forming continually.

Amount appropriated by act of August 11, 1888.....	\$5,000.00
July 1, 1889, amount expended during fiscal year.....	4,768.99

July 1, 1889, balance available.....	231.01
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{ Amount (estimated) required for completion of existing project.....	24,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix W 9.)

10. Bayous Rondeway and Vidal, Louisiana, by removing obstructions.—

This is a new work. The project, based upon an examination made in 1887, contemplated the removal of obstructions, chiefly leaning trees, from the canal and the part of Bayou Vidal which would remain open from the lake to the line of the levee proposed to be erected by State authority north of Lake Palmyra, etc., at an estimated cost of \$1,000.

The river and harbor act of August 11, 1888, appropriated \$1,000 for this purpose, and the work was completed in accordance with the project during the fiscal year.

The canal is claimed by owners of the land through which it runs, who propose to charge tolls on steam-boats passing through it, and the engineer officer in charge recommends that \$2,000 additional be expended in reopening the old bayou, to save the steam-boat interest from such imposition.

Amount appropriated by act of August 11, 1888.....	\$1,000.00
July 1, 1889, amount expended during fiscal year.....	1,000.00

{ Amount that can be profitably expended in fiscal year ending June 30, 1891	2,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix W 10.)

11. Big Black River, Mississippi.—The project for this improvement contemplated the removal of snags, logs, wrecks, and leaning trees obstructing navigation between the mouth and Cox's Ferry, 130 miles above, at an estimated cost of \$32,000. Such improvement can not be permanent, as new obstructions are added from time to time.

The first appropriation for this work, by act of 1884, was applied to removing obstructions in the 75 miles above the mouth. No work has been done since.

The appropriation in the act of 1886 contained the following proviso: "No part of this appropriation shall be used until the State of Mississippi shall have first caused the bridges south of the Vicksburg and Meridian Railroad to be so constructed as not to obstruct the navigation of said stream." This requirement has not been complied with yet.

July 1, 1888, amount available	\$5,000.00
July 1, 1889, balance available	5,000.00

{ Amount (estimated) required for completion of existing project.....	22,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix W 11.)

12. *Yazoo River, Mississippi*.—Work in this river was begun in 1873 by removing the wrecks of eleven steam-boats sunk during the war. The project contemplates the removal of wrecks, logs, snags, leaning trees, etc., which obstruct the channel throughout the entire length of the stream. No permanent improvement can be effected, as each flood brings new obstructions into the river, and others are added by sliding banks, etc.

The amount expended to June 30, 1888, was \$157,006.56. The large number of wrecks and natural obstructions which limited navigation of the stream had been removed to such an extent that the river was navigable from its head to its mouth the entire year.

In the past fiscal year \$20,551.18 has been expended for repairing the snag-boat *Meigs*, and for operations of this boat in January, May, and June. By the terms of the act of August 11, 1888, \$8,000 shall be used for constructing a pumping dredge-boat, and it is probable that the balance available for removing snags, etc., will be expended by the end of October, 1889.

July 1, 1888, amount available	\$993.44
Amount appropriated by act of August 11, 1888	32,000.00
	<hr/> 32,993.44
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	20,551.18
July 1, 1889, balance available	12,442.26
	<hr/> 50,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	
{ Submitted in compliance with requirements of sections 2 of river and	
{ harbor acts of 1866 and 1867.	
(See Appendix W 12.)	

13. *Tchula Lake, Mississippi*.—The project for this improvement was adopted in 1881, and contemplated the removal of snags, logs, leaning timber, etc., obstructing navigation, to enable light-draught steam-boats to enter the lake earlier in the season.

The amount expended to June 30, 1888, was \$8,999.22.

In the past fiscal year a snag-boat was employed from February 1 to 19 in removing the heavier obstructions. The amount expended was \$1,279.35. The available balance will be applied to clearing the banks of timber and brush, etc., so far as practicable with the amount.

No permanent improvement can be effected, as new obstructions are forming continually.

July 1, 1888, amount available	\$0.78
Amount appropriated by act of August 11, 1888	3,000.00
	<hr/> 3,000.78
July 1, 1889, amount expended during fiscal year, exclusive of liabilities out-standing July 1, 1888	1,279.35
July 1, 1889, balance available	1,721.43
	<hr/> 6,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	
{ Submitted in compliance with requirements of sections 2 of river and	
{ harbor acts of 1866 and 1867.	
(See Appendix W 13.)	

14. *Tallahatchee River, Mississippi*.—This improvement was begun in 1879. The project contemplated the removal of snags, sunken logs, and leaning timber obstructing low-water navigation below mouth of Coldwater River, a distance of 165 miles, and the removal of a wreck

lying in the channel 8 miles above the mouth. The estimated cost of such improvement was \$40,000.

The amount expended under this project to June 30, 1888, was \$27,500, and there had been expended above mouth of Coldwater \$10,000. Before improvement the river from mouth of Coldwater to Yazoo River was navigable about six months of the year. Boats from the Yazoo now run to Sharkey's Landing, 100 miles above the mouth, the entire year.

The snag-boat *Meigs* commenced operations in this stream in May, 1889, and continued in June until interrupted by high water. Work will be resumed as soon as the water falls sufficiently, and the available balance will be expended by October.

Many dangerous obstructions remain, and others caused by sliding and caving banks are forming continually. The amount estimated for can be profitably expended during the fiscal year ending June 30, 1891, in removing obstructions from the channel and in clearing the banks.

Amount appropriated by act of August 11, 1888	\$5,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	2,048.11

July 1, 1889, balance available	2,951.89
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{ Amount (estimated) required for completion of existing project	17,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867	

(See Appendix W 14.)

15. *Steele's Bayou, Mississippi*.—The project for this improvement contemplates the removal of snags, logs, stumps, leaning trees, etc., obstructing high-water navigation.

The amount expended to June 30, 1888, for this purpose was \$4,699.20. A steam-boat was employed 16 days in February, 1889, removing obstruction, and then withdrawn on account of high water. The amount expended was \$2,130.15. The balance available will be applied to removing obstructions from the lower part of the bayou.

July 1, 1888, amount available	\$300.80
Amount appropriated by act of August 11, 1888	2,500.00
	2,800.80

July 1, 1888, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	2,130.15
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July 1, 1889, balance available	670.65
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{ Amount that can be profitably expended in fiscal year ending June 30, 1891	5,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867	

(See Appendix W 15.)

16. *Big Sunflower River, Mississippi*.—The project for improving this stream was adopted in 1879, and contemplated building wing-dams to scour a channel of from 3 feet to 40 inches over the bars, and the removal of snags, sunken logs, and leaning timber obstructing navigation, at an estimated cost of \$66,000.

The amount expended to June 30, 1888, was \$47,000. Obstructions were removed and an increased depth of channel of from 18 inches to 3½ feet gained at the bars where dams had been built. When work was begun in 1879 the stream was navigable about six months in the year. During 1888-'89 it was navigable all the year.

In the past fiscal year the removal of obstructions and construction of dams were carried on from June 7 until the end of the month by means of a steam-boat hired for the purpose. This work will be continued, and the funds probably will be exhausted by the end of July, 1889.

Amount appropriated by act of August 11, 1888.....	\$5,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	3,243.73
July 1, 1889, balance available.....	1,756.27
{ Amount (estimated) required for completion of existing project.....	14,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix W 16.)	

17. *Big Hatchee River, Tennessee.*—This improvement was begun in 1880. The project contemplated the removal of logs, snags, leaning timber, etc., obstructing navigation from Bolivar, Tenn., to the mouth, about 240 miles, to render that portion of the river navigable for light-draught boats throughout the year. The improvement will not be permanent, as new obstructions form from time to time.

Before improvement navigation was virtually suspended by reason of the obstructions. The amount expended to June 30, 1888, was \$22,000, rendering the river navigable about seven months of the year.

During the fiscal year a chopping party expended \$1,989.02 in removing obstructions in the 55 miles above Rialto. The available balance will be applied to the removal of logs and snags from the channel.

Economy would be subserved by expending in one season an amount sufficient to clear the river of obstructions, so as not to require further work for several years. Ten thousand dollars can be applied profitably to this purpose during the fiscal year ending June 30, 1891.

Amount appropriated by act of August 11, 1888.....	\$5,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	1,989.02
July 1, 1889, balance available.....	3,010.98
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix W 17.)	

18. *Forked Deer River, Tennessee.*—Work in South Fork was begun in 1883. The project contemplated the removal of snags, logs, leaning timber, etc., obstructing navigation from the mouth to Sharon, about 114 miles above, at an estimated cost of \$19,250. Operations, however, were extended to Jackson, the head of navigation, 81 miles above Sharon. The work is not permanent, as obstructions are added from time to time.

The amount expended on the South Fork to June 30, 1888, was \$10,000.

The act of August 11, 1888, appropriated \$2,500 for continuing improvement of South Fork, \$4,500 for the North Fork, below Dyersburgh, and \$2,500 for the main river below. The removal of snags, logs, leaning timber, etc., was carried on in all three streams during the fiscal year, but high water interfered greatly with operations in the main river. The amounts expended were \$2,500 in South Fork, \$3,862.85 in North Fork, and \$1,616.36 in main river. Total, \$7,979.21.

On account of the numerous bridges obstructing South Fork no further improvement is deemed advisable at present, and after expending the balance available for North Fork nothing further should be required in it for several years, or until the main river has been put in equally good condition. The obstructed condition of the latter prevents navigation of the two forks for at least three months of the year, and \$5,000 can be expended profitably in one season's work in the main stream.

Amount appropriated by act of August 11, 1888.....	\$9,500. 00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	7,979. 21

July 1, 1889, balance available.....	1,520. 79
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{ Amount that can be profitably expended in fiscal year ending June 30, 1891	5,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix W 18.)

19. *Water-gauges on the Mississippi River and its principal tributaries.*—Section 5252 Revised Statutes authorizes and directs the Secretary of War to have water-gauges established and daily observations made of the rise and fall of the Lower Mississippi River and its chief tributaries at or in the vicinity of certain points named, and at such other places as he may deem advisable.

The gauges were established in 1871, and, with a few exceptions, a complete record of the daily readings at all stations has been obtained from January, 1872, to the present time. By the terms of the statute the sum of \$5,000 was to be available annually for these gauges. This amount, however, has not been appropriated regularly, and, as reported heretofore, it has been difficult to make the work continuous on this account. The amount expended to June 30, 1888, was \$67,100.

During the fiscal year observations were continued at all the gauges, and inspections and repairs made when the stages of water would permit. Nearly all the gauges require rebuilding, and this work will be done as soon as the water falls sufficiently.

It is recommended that additional gauges be established at Fulton and Garland, Ark., and Shreveport, La., on Red River.

Section 6 of the river and harbor act of August 11, 1888, provides a permanent appropriation "for the purpose of securing the uninterrupted gauging of the waters of the Lower Mississippi River and its tributaries."

Amount appropriated by act of August 11, 1888.....	\$9,600. 00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$7,133. 71
July 1, 1889, amount allotted for gaugings at St. Paul.....	900. 00

8,033. 71

July 1, 1889, balance available.....	1,566. 29
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Amount that can be profitably expended in fiscal year ending June 30, 1891 (provided for by act of August 11, 1888)	9,600. 00
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(See Appendix W 19.)

EXAMINATIONS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examinations of the following localities were made by the local engineer in charge, Captain Willard, and reported by him as not worthy of improvement, with facts and reasons for such

opinion. The Chief of Engineers, concurring in the conclusions reached in these instances, has given no instructions to make further survey with the view to their improvement:

1. *Bogue Phalia, Mississippi, especially the part known as the Narrows, with view to its improvement.*—(See Appendix W 20.)

2. *Bayou Dorcheat, Louisiana, from Lake Bisteneau to the Arkansas line.*—(See Appendix W 21.)

The required preliminary examination of *Ouachita River, Louisiana and Arkansas, from its mouth to head of navigation, to determine the advisability and probable cost of its permanent improvement*, was made by the local engineer in charge, Captain Willard, and reported by him as not worthy of permanent improvement, but worthy of further improvement under the adopted project, with facts and reasons for such opinion. The Chief of Engineers, concurring in the conclusions reached in this instance, has given no instructions to make further survey. (See Appendix W 22.)

IMPROVEMENT OF ARKANSAS RIVER; OF RIVERS IN THE STATE OF ARKANSAS, AND THE BLACK, ST. FRANCIS, AND LITTLE RIVERS, IN ARKANSAS AND MISSOURI.

Officer in charge, Capt. H. S. Taber, Corps of Engineers. Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. *Red River above Fulton, Arkansas.*—The first appropriation was made by act approved August 5, 1886. Prior to this time this river was choked with masses of drift-wood, isolated snags, and logs, and many overhanging trees added to the difficulties of navigation. The originally adopted project contemplates high and medium stage navigation only; \$6,911.50 had been expended up to June 30, 1888, removing nearly eight hundred dangerous low-water snags. By the act which became a law August 11, 1888, \$3,000 was appropriated. During the fiscal year ending June 30, 1889, \$3,077.30 has been expended in the continuance of the original project, which carried the work to within 75 miles of the point in the river to which work was to be carried. Had the appropriation been made as a whole, work would have been completed within the estimate (\$10,000); \$2,000 is required during fiscal year ending June 30, 1891; \$1,000 to complete the original project, and \$1,000 to remove snags that have accumulated in the improved river out of the unimproved.

July 1, 1888, amount available.....	\$88.50
Amount appropriated by act of August 11, 1888.....	3,000.00

	3,088.50
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	3,077.30

July 1, 1889, balance available.....	11.20
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{ Amount (estimated) required for completion of existing project annually	1,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	2,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix X 1.)

2. *Little Red River, Arkansas.*—The only improvements ever attempted upon this river were made in 1872. Prior to this work many overhanging trees and a large number of snags interfered with navigation in the lower reaches, and many boulders obstructed flat-boat and

raft navigation in the reach above the present town of Judsonia. Most of the overhanging trees and snags were removed as high as Judsonia and the bowlders remained untouched to the end of June 30, 1886. The act approved August 5, 1886, appropriated \$3,000. The amount estimated as actually necessary was \$8,400—\$400 for the bowlders, \$8,000 for dredging a channel through the shoals.

Up to June 30, 1888, \$612.90 had been expended in removing the bowlders and in care of the property. The balance, being inadequate to build a dredge, was held to await further action of Congress.

By the act of August 11, 1888, the balance, \$5,400, of the original estimate was appropriated. During the fiscal year ending June 30, 1889, \$5,008.90 has been expended in the continuance of the project.

July 1, 1888, amount available	\$2,387. 10
Amount appropriated by act of August 11, 1888	5,400. 00
	<hr/> 7,787. 10

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$5,682. 71
July 1, 1889, outstanding liabilities.....	35. 00
	<hr/> 5,717. 71

July 1, 1889, balance available.....	2,069. 39
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(See Appendix X 2.)

3. *Removing obstructions in Arkansas River, Arkansas.*—Prior to the first improvements, in 1833, shifting sand-bars, numerous drift-piles, and dangerous snags constituted the obstacles to navigation in the lower reaches, and gravel and rock shoals, with a few snags and many overhanging trees, constituted those of the upper. Except for a few special reaches, like the Fort Smith and Pine Bluff, the general plan of improvement has consisted in snagging operations, including the cutting of overhanging trees, in building wing-dams to improve the shoals, and in surveys looking toward plans for its permanent improvement.

The appropriations to June 30, 1889, amount to \$465,251.87. Of this there had been expended to June 30, 1888, \$367,477.89. During the fiscal year ending June 30, 1889, \$13,090.79 was expended in the construction of a new hull for the snag-boat *Wichita* and care of property and records. The water was not at a suitable stage for economical work after the completion of the snag-boat.

The building of another light-draught snag-boat, after the model of the new *Wichita*, is recommended.

The removal of obstructions will be continued with the amount on hand and the work on the maps will be completed.

July 1, 1888, amount available.....	\$248. 67
Amount appropriated by act of August 11, 1888	25,000. 00
	<hr/> 25,248. 67

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$12,853. 79
July 1, 1889, outstanding liabilities.....	237. 00
	<hr/> 13,090. 79

July 1, 1889, balance available.....	12,157. 88
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{ Amount (estimated) required for completion of existing project, annually	35,000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	35,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix X 3.)

4. *Arkansas River, Arkansas.*—By act of August 5, 1886, \$75,000 was appropriated for continuing the improvement of Arkansas River, in accordance with the plan and recommendations contained in Appendix V 13, House Ex. Doc. No. 1, Forty-ninth Congress, first session, which provided that \$8,000 be expended at Pine Bluff, \$13,000 at Fort Smith, and \$10,000 at Dardanelle, or so much thereof as may be necessary.

The approved project for the expenditure of this sum is as follows:

At Pine Bluff the \$8,000 to be used in extending and repairing the dikes and or protecting the town front.

At Fort Smith the \$13,000 to be expended in erecting a permeable dike a little above the town to retain the channel along the city wharves.

At Dardanelle the \$10,000 to be expended in erecting a permeable dike above the town to remove the sand-bar now in front of the wharves.

From Little Rock to the mouth, the balance, and so much as may not be required at the three places above specified, to be expended in the erection of permeable dikes at the worst places, looking towards the permanent improvement of the river to give at least a depth of 5 feet at extreme low water.

By act of August 11, 1888, \$150,000 was appropriated under this head, as follows:

Improving Arkansas River, Arkansas: Continuing improvement, one hundred and fifty thousand dollars: *Provided*, That nothing herein contained shall authorize the Secretary of War to enter upon project of improvement of said river as set forth in the report of the Board of Engineers on improvement of the Arkansas River from Wichita, Kansas, to its mouth, dated New York City, March sixteenth, one thousand eight hundred and eighty-eight, and contained in House Executive Document number two hundred and thirty-four, first session, Fiftieth Congress: *Provided*, That the Secretary of War shall expend the appropriation under this head with reference to the final improvement of this river as contemplated in the report of the Chief of Engineers for the year ending July first, one thousand eight hundred and eighty-five, and as authorized in the act for the improvement of rivers and harbors approved August fifth, one thousand eight hundred and eighty-six, and in House Executive Document number ninety, Forty-ninth Congress, first session, said methods to be applied as the Secretary of War may direct at such points between Wichita, Kansas, and the navigable mouth of the Arkansas River at its junction with the Mississippi River, as he may deem for the best interests of commerce. And all moneys now to the credit of different sections of the Arkansas River, other than the appropriations for the operating of the snag-boats, shall be available for use under this head; and in future the engineer in charge of this work and the Secretary of War shall make report upon the progress and needs of this work under this head, instead of reporting upon disconnected projects, as heretofore. Nothing herein contained shall be understood to prevent the Secretary of War from applying any part or all of the funds previously appropriated for use at Fort Smith, Dardanelle, in Pine Bluff reach, or from expending not exceeding four thousand dollars to remove the bar in front of Van Buren, or from allotting not exceeding eight thousand dollars as a contingent fund for the expenditure in Pine Bluff reach.

The approved project for the expenditure of this sum may likewise be summarized as follows:

At Pine Bluff the same as above.

At Van Buren the \$4,000 to be expended in erecting a permeable dike at a suitable point, a little above the town, and upon the opposite side of the river, to contract the channel and prevent it from leaving the city wharves.

From Fort Gibson, Ind. T., to the mouth of the river, the balance to be expended in the erection of permeable dikes, and in one instance, by rock excavation, at the worst places, or the places at which serious interference with the largest amount of commerce occurs, so far as the amount of the appropriation will permit, looking toward the permanent improvement of the river to give the channel as provided under the act of August 5, 1886, from Little Rock to the mouth; and an all-year-round

depth of water of at least 2 feet from Little Rock, Ark., to Fort Gibson, Ind. T.

Before operations were begun at Fort Smith the old jetty at that place, built in 1877 and 1878, had so far disappeared as to render no service, and the river was about to throw a bar along the wharves of the town.

At Dardanelle a bad bar had formed along the town front, cutting off all approach to either wharf at low water or at medium stage.

From Fort Gibson to the mouth of the river the river consists of alternating bars and caving banks, with crossings more or less troublesome at low water, a few of the latter operating to effectually close the river to navigation at extreme low water for even boats drawing but 2 feet of water.

During the fiscal year ending June 30, 1889, \$6,044.09 has been expended at Pine Bluff in the erection of a new dike and repairing one of the light ones.

At Dardanelle \$2,944.62 was expended erecting 200 additional feet of dike. So far the results obtained have been in every way satisfactory.

At Van Buren, Ark., \$3,432.47 was expended in erecting a permeable spur-dike, above and opposite the town, for the purpose of deepening the channel next to the wharf.

From Fort Gibson, Ind. T., to the mouth \$23,513.95 has been expended according to projects. This erected one dike and repaired another above the Baring Cross Bridge with very successful results in bringing the channel of the river back to the draw-span. It also erected two dikes below the Little Rock and Fort Smith Railway Bridge at Little Rock, accumulated material, and prepared plant. Continued low water prevented an early examination of the river, delaying projects. Everything is in readiness to push the work during the next low-water season.

The results from the general work have been satisfactory wherever the dikes have been erected a sufficient time to produce results.

The work done at White Bluff and Eagle Bend in the fiscal year ending June 30, 1888, is in every way a success.

It has been difficult to work advantageously with so small an appropriation. If *prompt economical* results are expected at least \$250,000 should be made available for the fiscal year ending June 30, 1891, and it will require according to this plan \$3,651,479 to complete the improvement.

July 1, 1888, amount available.....	\$10,009.54
Amount appropriated by act of August 11, 1888	150,000.00

160,009.54

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$35,935.13
July 1, 1889, outstanding liabilities.....	1,778.59
	<hr/> 37,713.72

July 1, 1889, balance available.....	122,295.82
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[Amount (estimated) required for completion of existing project.....	3,651,479.00
[Amount that can be profitably expended in fiscal year ending June 30, 1891	250,000.00
[Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix X 4.)

5. *Petit Jean River, Arkansas.*—Before improvement this river was obstructed by snags, logs, masses of driftwood, overhanging trees, and shoals. The original project for improvement contemplated rendering it navigable during high and medium stages of water, as high as Danville, Ark., by cutting the overhanging trees and cutting up the snags,

logs, and drift; \$8,500 were expended in the execution of this to June 30, 1888. The appropriation made by act approved August 11, 1888, amounts to \$2,500 and limits the work to below the bridge at Rocky Crossing. The new project for this provides for removing portions of the shoals known as Slaty Crossing, and Robinson's Ridge, and certain timber from the low-water channel. During the fiscal year ending June 30, 1889, no work was done because of the near approach and the continuance of high water, rendering it more advantageous to wait until about September 1, 1889. The recommendation for the balance required on the original project, \$3,500, is renewed.

Amount appropriated by act of August 11, 1888.....	\$2,500.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	49.48

July 1, 1889, balance available.....	2,450.52
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{ Amount (estimated) required for completion of existing project.....	3,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	3,500.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix X 5.)

6. *Fourche River, Arkansas.*—The improvement of this stream was begun in 1879, under the act approved March 3, 1879. Prior to any improvement its channel was choked with snags, logs, and drift, and heavy timber overhung its banks. Several bad shoals also impeded navigation.

Up to June 30, 1886, \$21,000 had been expended in removing the greater part of the obstructions, though the shoals and now and then a snag that has washed in since work was suspended in December in 1882, still offer serious obstacles to navigation at medium stages of water.

By act approved August 5, 1886, \$5,000 was appropriated for removing rock shoals situated about 4 miles below Perryville. At the close of the fiscal year ending June 30, 1888, this sum had been expended, completing a channel about 500 yards long, 30 feet wide, and 2 feet deep, at low water, through this shoal.

As no appropriation was made by the act of August 11, 1888, no work was done during the fiscal year ending June 30, 1889.

{ Amount (estimated) required for completion of existing project.....	\$7,650.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	7,500.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix X 6.)

7. *White River, Arkansas.*—Prior to improvement this river was choked with drift-piles, logs, and snags in its lower portion, and from Batesville up, gravel bars, rocky shoals, channel boulders, and overhanging trees impeded navigation.

The originally adopted project consisted in snagging operations and blasting of ledges and bowlders, and dam building to remove gravel bars or to close chutes.

The first separate appropriation for this river was made by act approved July 5, 1884. Provision for a survey of the river from Forysthe, Mo., to its mouth, was added to the original project. At that time the river was in excellent navigable condition for boats drawing not to exceed 3 feet of water, from its mouth to Newport, Ark. From Newport to Batesville there were many troublesome snags, and from Batesville

to Buffalo Shoals there were numerous bad shoals, rendering navigation very uncertain. From Buffalo Shoals to Forsythe, Mo., there were many fine reaches of river, but the depth of water on Buffalo Shoals and others prevented any navigation at ordinary stages of water.

Up to June 30, 1888, \$51,359.65 had been expended. This completed the survey, plotted the notes, published the maps, effectively improved the most dangerous shoals between Buffalo Shoals and Batesville, removed the more dangerous snags from Batesville to the mouth, and left a small balance, \$1,652.35. It was deemed advisable to reserve this small balance, as it could be used more effectively for permanent improvement.

By the act of August 11, 1888, \$25,000 was appropriated; \$58,000 was specified as the sum which could be properly expended the first fiscal year. The present plan provides for the maintenance, at low water, of a channel 2 feet deep between Newport and Buffalo Shoals and a channel of not less than 5 feet deep at low water, from Newport to the mouth, and also for a limited amount of snagging operations while these improvements are in progress. The result between Newport and Buffalo Shoals is to be accomplished by the erection of solid wing-dams and some rock excavations. From Newport to the mouth is to be accomplished by the erection of low permeable spur-dikes to give the necessary depth of water to the shoals, yet not to remove the shoals to a point below, or to cave the opposite banks.

During the fiscal year ending June 30, 1889, \$10,066.12 was expended in the construction and equipment of six barges, a floating pile-driver, repairs to the quarter-boat, care of property, and snagging operations between Batesville and the mouth. The season at which low water occurs precluded any additional work advantageously and economically.

Everything is in order to begin work when next low-water season arrives.

Great commercial interests due to inexhaustible mineral resources are concentrated upon the immediate improvement of this river. The improvements will be of a very permanent character.

To save all expense of caring for plant and repairing the same during the interval of two or more appropriations, it would be more economical and advantageous to make all the balance available in one season. At least \$60,000 should be made available for the fiscal year ending June 30, 1891.

July 1, 1888, amount available.....	\$1,652.35
Amount appropriated by act of August 11, 1888.....	25,000.00
	<hr/> 26,652.35
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$10,066.12
July 1, 1889, outstanding liabilities.....	328.33
	<hr/> 10,394.45
July 1, 1889, balance available	<hr/> 16,257.90
<hr/>	
{ Amount (estimated) required for completion of existing project.....	83,815.00
{ Amount (estimated) required for snagging annually.....	8,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	60,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix X 7.)

8. *Cache River, Arkansas.*—The appropriation available is the first ever made for this reach of river. Prior to the work its channel was choked with logs and snags, overhanging trees interfered with the

smokestacks of steamers, and several shoals obstructed the low-water navigation.

The present project proposes the removal of the logs, snags, and overhanging trees, from the town of Riverside, Ark., to the mouth of the river. This operation will incidently improve the shoals, as they are caused in the majority of cases by an accumulation of logs.

Seven thousand dollars was the amount appropriated, \$3,000 for the construction of a snag-boat, \$4,000 for its operating expenses.

During the fiscal year ending June 30, 1889, \$3,970.06 was expended building the snag-boat *Riverside*, equipping the same, and carrying out the provisions of the project. Continuous low-water season beginning late in the fiscal year, little time was had for removing obstructions. Work done being within the estimate, it is expected that the work required will be completed with the present appropriation.

Amount appropriated by act of August 11, 1888	\$7,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$3,970.06
July 1, 1889, outstanding liabilities.....	408.64
	<hr/> 4,378.70

July 1, 1889, balance available.....	2,621.30
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(See Appendix X 8.)

9. *Black River, Arkansas and Missouri.*—Before any improvements were made upon this river its channel was choked with logs and snags, and obstructed by overhanging trees, and in many places shoals interfered with its navigation at low water by any but very light-draught boats. The original plan for its improvement contemplated the removal of the obstructions and the improvement of the shoals, the latter by wing-dams. A few sloughs were to be closed so as to confine the water to the main channel.

Up to June 20, 1888, \$56,242.40 had been expended for these purposes, and good progress made toward connecting with some detached work near Poplar Bluff, Mo., i. e., only 60 miles of unworked river intervenes. By act of August 11, 1888, \$5,000 was appropriated.

During the fiscal year ending June 30, 1889, \$2,121.19 was expended in carrying out the original project. The stage of water being too high for effective work, the balance is held for the next low-water season, which occurs in July and August. It is hoped that this balance with that for improving Black River, Missouri, will open in a general way the reach specified.

Amount appropriated by act of August 11, 1888.....	\$5,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	2,121.19
July 1, 1889, balance available.....	<hr/> 2,878.81

{ Amount (estimated) required for completion of existing project, annually	8,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	8,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix X 9.)

10. *Black River, Missouri.*—The first improvements attempted upon this reach of river were made in the years 1881 and 1882. Prior to this work its channel was choked with logs and snag, and obstructed by overhanging trees, and in many places shoals interfered with its navigation at low water by any but very light-draught boats.

The original plan for its improvement contemplated the removal of the obstructions, and the improvement of the shoals, the latter by wing-dams. A few sloughs were to be closed up, so as to confine the water to the main channel. Up to June 30, 1888, \$6,000 had been expended, which had opened up about 20 miles of river from Poplar Bluff towards the mouth. Owing to the difficulty in getting suitable appliances up to this reach, it was carried on under great disadvantages.

During fiscal year ending June 30, 1889, the snag-boat *Henry Sheldon* (specially constructed for use on this river) was worked to Poplar Bluff from below and operated from there down the river, expending \$6,562.30, rapidly and effectively clearing the reach worked of obstructions, erecting a strong dam (at the head of Dan River, a chute of the Black River), raising the water in the other chute, and carrying the work to the Arkansas State line, removing the greater part of the dangerous snags and making a good beginning upon overhanging timber.

Amount appropriated by act of August 11, 1888.....	\$7,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$6,562.30
July 1, 1889, outstanding liabilities.....	238.50

6,800.80

July 1, 1889, balance available.....	199.20
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{ Amount (estimated) required annually	6,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.....	

(See Appendix X 10.)

11. *St. Francis River, Arkansas*.—The first appropriation was made March 2, 1833, prior to which this river was choked with drift-piles, logs, snags, and its waters spread out through a great variety of sloughs, while overhanging trees added to the difficulty of navigation. The originally-adopted project was principally for snagging operations, and attempts have been made to close up some of the many sloughs. Appropriations for this river having been united with the White River, exactly how much had been expended upon the St. Francis River to June 30, 1884, can not well be stated. July 5, 1884, the first separate appropriation was made, amounting to \$12,000. August 5, 1886, \$8,000 more followed.

By act of August 11, 1888, \$4,000 was appropriated.

During the fiscal year ending June 30, 1889, \$1,888.77 has been expended in the continuance of the original project.

July 1, 1888, amount available.....	\$3.38
Amount appropriated by act of August 11, 1888	4,000.00

4,003.38

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	1,888.77
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July 1, 1889, balance available.....	2,114.61
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{ Amount (estimated) required for completion of existing project, annually	8,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	8,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.....	

(See Appendix X 11.)

12. *St. Francis River, Missouri*.—The appropriation available is the first ever made for this reach of river. Prior to the work done in the fiscal year ending June 30, 1889, its channel was choked with logs and snags; overhanging trees interfered with smoke-stacks, and several

shoals interfered with low-water navigation. The estimate, \$3,700, proposed the removal of the shoals about 12 miles below Greenville and the removal of snags and other obstructions only, as the amount appropriated, \$5,000, by act of August 11, 1888, is not large enough to warrant attempting the shoals also.

During the fiscal year ending June 30, 1889, \$3,062.21 was expended cutting a channel through 600 feet of drift-wood and carrying out the other provisions of project. Much delay was experienced, due to the obstruction offered by the railroad bridge over the St. Francis River at St. Francis. It was necessary to dismantle the boat and rebuild it in order to pass the bridge. From progress made in the work so far it would appear that the snagging and removal of overhanging timber will be practically completed on present appropriation.

To complete it and remove the shoals and care for the property in the interim, the balance originally estimated, \$2,300, and \$200 as a contingent, will be required.

Amount appropriated by act of August 11, 1888	\$5,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$3,062.21
July 1, 1889, outstanding liabilities	406.75
	<hr/> 3,468.96
July 1, 1889, balance available	<hr/> 1,531.04
{ Amount (estimated) required for completion of existing project	2,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	2,500.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix X 12.)	

13. *Little River, Missouri and Arkansas.*—Before improvement this river was obstructed by snags, logs, masses of drift-wood, and shoals, and was divided into two chutes. The project for improvement contemplates prolonging medium-stage navigation by closing one of the chutes and removing the obstructions enumerated from the other. The snag-boat for this work not being available, no work was done during the fiscal year ending June 30, 1889. The work will probably be begun within the next six or eight months. The appropriation of the balance of the \$8,000 is recommended.

Amount appropriated by act of August 11, 1888	\$5,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	29.69
July 1, 1889, balance available	<hr/> 4,970.31
{ Amount (estimated) required for completion of existing project	3,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	3,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix X 13.)	

REMOVING SNAGS AND WRECKS FROM THE MISSISSIPPI AND MISSOURI RIVERS—IMPROVEMENT OF THE MISSISSIPPI BETWEEN THE MOUTHS OF THE ILLINOIS AND OHIO RIVERS—IMPROVEMENT OF OSAGE AND GASCONADE RIVERS, MISSOURI.

Officer in charge, Maj. A. M. Miller, Corps of Engineers. Division Engineer, since December 3, 1888, Col. C. B. Comstock, Corps of Engineers.

1. *Removing snags and wrecks from the Mississippi and Missouri rivers.*—*Mississippi River*—The navigation on this river was greatly hampered

by the numerous snags, logs, etc., which were lodged in the channel, and to which a new accession was brought down on each rise of the river, thus constantly adding new and unknown obstructions to those already there. A large number of wrecks also occupied the channel and were very dangerous to the safety of passing boats.

For the removal of these obstructions appropriations were made as early as 1824, and the project consisted in building boats suitable for removing the snags, etc., and operating them whenever the stage of water was favorable for the work and funds were available.

The total amount expended for this purpose can not be definitely given, as previous to the appropriation made by act of March 3, 1879, a general amount was appropriated to be applied to several streams as their needs required. From March 3, 1879, when the first specific appropriation was made, up to June 30, 1888, \$565,428.16 was expended for this purpose. The navigation of the river has been very materially improved by this method, and the danger of accidents to boats lessened.

During the fiscal year ending June 30, 1889, \$67,511.37 was expended. Three snag-boats were employed between the mouth of the Missouri River and Natchez, Miss., removing obstructions. The boats worked for a total of nine and one-half months, removing 1,864 snags, cutting down 9,102 trees, removing 34 drift piles and 8 wrecks, and traveling a distance of 6,030 miles, thereby greatly benefiting navigation and commerce.

Much needed repairs were also made to the snag-boats and they are now in good condition to resume work as soon as the stage of water will permit.

An annual appropriation having been made for carrying on this work no further estimate is submitted.

July 1, 1888, amount available.....	\$3,772.47
Amount appropriated by act of August 11, 1888.....	100,000.00
	<hr/> 103,772.47
July 1, 1889, amount expended during the fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$67,511.37
July 1, 1889, outstanding liabilities.....	3,289.15
	<hr/> 70,800.52
July 1, 1889, balance available.....	32,971.95
(See Appendix Y 1.)	

Missouri River.—The necessity for the improvement of this stream was first recognized in 1832, as its navigation was rendered difficult and dangerous by numerous snags, etc., in the channel, and leaning timber on the banks of the river.

The plan adopted for its improvement was the removal of these obstructions by snag-boats, and they have been used to great advantage.

The first appropriations having been made so as to cover the needs of several streams, the total amount expended on this river for the removal of obstructions can not be given. Since June 18, 1878, when the first specific appropriation was made, up to June 30, 1888, \$459,751.75 was expended in that manner, greatly improving navigation during the low-water season.

During the fiscal year ending June 30, 1889, \$765.45 was expended in watching and caring for snag-boats.

By the terms of the river and harbor act of August 11, 1888, this work was placed under the Missouri River Commission, and the snag-boat *C. R. Suter*, and other property belonging to the work was transferred to Lieut. Col. C. R. Suter, Corps of Engineers, president Missouri

River Commission, on September 28, 1888, by direction of the Secretary of War.

July 1, 1888, amount available.....	\$2,748.25
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	765.45

July 1, 1889, balance available.....	1,982.80
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(See Appendix Y 1.)

2. *Mississippi River, between the Ohio and Illinois rivers.*—The original condition of the navigable channel of this portion of the Mississippi River, before the work of improvement was begun, was such that the natural depth at low water was in many cases from 3½ to 4 feet and the water was scattered by islands which formed sloughs behind them, thus wasting the water available for low-water navigation.

The project for improvement adopted consisted in closing these sloughs and by contraction works to concentrate the water between banks 2,500 feet apart, the object being to thus obtain a depth of 8 feet in the channel between St. Louis and Cairo and 6 feet between Grafton and St. Louis at standard low water, or at a stage corresponding to a gauge reading of 4 feet on the St. Louis gauge.

The amount expended up to the close of the fiscal year ending June 30, 1888, was \$3,648,150.11. The condition of the improvement at this latter date was such that a good channel of not less than 8 feet was maintained from St. Louis to Bushberg, a distance of 27 miles, as far as work had been carried up to that time.

The amount expended during the fiscal year ending June 30, 1889, was \$173,827.34. The work accomplished by this expenditure having been almost entirely done since the beginning of March, 1889, it has not been sufficiently long in place to state as yet what results it has produced in increasing the depth and otherwise benefiting navigation; but reasoning from analogy and from results produced heretofore by the same system and methods, it may be confidently stated that the results will be very beneficial to navigation in increasing the channel depth.

During the fiscal year ending June 30, 1889, work was done at the following localities:

Horsetail.—The work at this locality consisted in the repair of the hurdle, closing the chute to the east of Carroll's Island, which had been damaged by ice and partially burned down by hunters or fishermen during the winter; 450 feet of hurdle was built and the bank revetment at head of island repaired. This work may be considered as completed and has resulted in an average fill of about 12 feet over an area of 1,000 acres, has reduced the river to a width of 2,500 feet, and rendered it navigable for the largest boats, and removed one of the worst bars in the river ("Horsetail"), where trouble was always met with at low water. The amount expended during the fiscal year ending June 30, 1889, was \$4,093.58.

Twin Hollows.—The work at this locality consisted in the revetment of the artificial bank near the head of the works, which showed a tendency to erosion. The work was done on the west bank, and 115,450 square feet of protection, consisting of brush mattress and stone, was placed in position, protecting a length of 1,570 feet of bank. Amount expended during fiscal year ending June 30, 1889, was \$7,817.65.

Pulltight.—The project for the improvement of this locality was adopted in 1881. The river at this point has shown a decided tendency to make a "crossing" above the point originally projected, and a careful study of the locality was made and works laid out in conformity

with this tendency. Four hurdles were projected to be built from the east bank, in order to throw the river across the middle bar here existing.

Work was begun on the two upper hurdles in March, the two lower having been built the previous year. These hurdles were nearly completed when they were badly broken about the last of May by drift brought down by a sudden rise, and work has since then consisted in their repair. These repairs were nearly completed at the end of the fiscal year.

The effect of these hurdles can not be determined till low water, but from present appearances they will accomplish the desired result of cutting away the middle bar; 2,775 linear feet of hurdles were constructed here and extensive repairs made.

The amount expended for the fiscal year ending June 30, 1889, was \$104,495.96.

Jim Smith's.—The project for the improvement of this locality consists in the construction of contraction works. On account of the existence of a very persistent middle bar it was determined to further extend the hurdles in order to close the chute to the east of the bar, and concentrate the water in such a manner as to remove it; two hurdles were extended an aggregate distance of about 1,500 feet, when the plant was removed to Pulltight to assist in the repairs at that point. Amount expended during fiscal year ending June 30, 1889, was \$14,079.66, which also includes amount expended at Sulphur Springs.

Sulphur Springs.—The work at this locality is contraction work, the hurdles extending from the east bank. The project for this locality contemplated the extension and repair of the hurdles. The plant being otherwise occupied, the only work accomplished was the wattling of hurdle No. 16 at the head of Foster's Island. The work at this locality has very much improved the lower crossing.

Lucas'.—The project for work at this locality was adopted in 1888. It consists in contracting the river width to 2,500 feet, and preventing the waste of water now flowing through the chute behind Calico Island. This is a new work; four hurdles were built here whose aggregate length is 7,170 linear feet; they have been constructed since March, 1889, and the effect of the work can not be absolutely stated until low water. It is the continuation of the general project which has succeeded above. Amount expended for fiscal year ending June 30, 1889, was \$67,427.60.

A reference to the plates accompanying the report of the officer in charge will give a graphic representation of the progress and effect of these works. The amount expended during the year was \$173,827.34, and the total amount expended to June 30, 1889, was \$3,822,005.54.

The original estimated cost of the work, as revised in 1883, was \$16,997,100. The aggregate amount appropriated to June 30, 1889, is \$4,039,600. The amount expended to June 30, 1888, is \$3,648,150.11.

July 1, 1888, amount available.....	\$95,658.37
Amount appropriated by act of August 11, 1888.....	300,000.00
	<hr/>
	395,658.37
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$173,827.34
July 1, 1889, outstanding liabilities.....	17,960.74
July 1, 1889, amount covered by existing contracts.....	32,507.95
	<hr/>
	224,316.03
July 1, 1889, balance available.....	171,342.34
	<hr/>

{ Amount (estimated) required for completion of existing project....	\$12,957,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891.....	600,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix Y 2.)

3. Gasconade River, Missouri.—This river was greatly obstructed by snags, logs, and leaning timber, which materially interfered with navigation. Work was commenced on this stream in 1880, and the project adopted for its improvement consisted in the removal of the snags and logs and the cutting of leaning timber and the construction of contraction works at shoal crossings.

The amount expended to June 30, 1888, was \$37,438.03, and at that time the navigation was much improved. During the fiscal year ending June 30, 1889, \$2,498.06 was expended in removing obstructions from the bed of the river and cutting down leaning timber from the banks, thereby rendering the navigation of the river much safer.

The original estimate for the improvement of this stream was \$50,000, of which \$42,500 has already been appropriated, leaving an estimated amount of \$7,500 to complete the project. This amount will probably be exceeded, as new obstructions are continually forming, and it will require a small amount each year to keep the channel open after the principal work has been done.

July 1, 1888, amount available	\$61.97
Amount appropriated by act of August 11, 1868	5,000.00
	<hr/>
	5,061.97
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	2,498.06
	<hr/>
July 1, 1889, balance available.....	2,563.91
	<hr/> <hr/>

{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867..	

(See Appendix Y 3.)

4. Osage River, Missouri.—The navigation of this stream was very much interfered with by obstructions in the channel and shoal crossings. The original project, adopted in 1871, was to obtain a low-water navigation of 2 feet by means of dams and training-walls, but this was abandoned and a new project, consisting in the removal of snags and logs, cutting of leaning timber and constructing dams and training-walls at shoal crossings, was adopted.

The amount expended to June 30, 1888, was \$195,844.52, at which time the navigation was in a fair condition, the worst obstructions having been removed. During the fiscal year ending June 30, 1889, \$4,248.52 was expended in extension and repair of dam and training wall at Hoskin's Shoal, in repairing dam at Moore's Flat, and in removing obstructions from 60 miles of the river. This improved the navigation at low water by increasing the depths over the shoals and making the navigation of the river much safer than formerly.

No estimate was made for the improvement of this stream under the second project; an annual appropriation is, however, required to keep this stream in navigable condition by the removal of new obstructions that are brought down during the floods.

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July 1, 1888, amount available	\$4, 155. 48
Amount appropriated by act of August 11, 1888.....	5, 000. 00
	<hr/> 9, 155. 48
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$4, 248. 52
July 1, 1889, outstanding liabilities.....	401. 50
	<hr/> 4, 650. 02
July 1, 1889, balance available	4, 505. 46
<hr/>	
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix Y 4.)	

EXAMINATIONS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examination of the *Grand River, Missouri*, was made by the local engineer in charge, Major Miller, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers, concurring in the conclusion reached in this instance, has given no instructions to make further survey with the view to its improvement. (See Appendix Y 5.)

St. Louis Harbor, Missouri, reported by the local engineer as worthy of improvement, and this conclusion is concurred in by the Chief of Engineers. The information at hand is sufficient to indicate to Congress the probable cost of the work required, and no further report or survey appears to be necessary. The improvement proposed contemplates contraction of the width of the river from a point opposite Bissell's Point to a point 4,500 feet above the bridge to 2,000 feet. Estimated cost \$182,000. (See Appendix Y 6.)

The required preliminary examination of *Missouri River at Miami, Missouri*, was made by the local engineer, Major Miller, and his report thereon may be found in Appendix Y 7. The river and harbor act of August 11, 1888, having made a specific appropriation of \$25,000 for the improvement of the Missouri River at this place, and as the Missouri River Commission has the work assigned to it by law, it was considered that no further action by this office was required.

The act also provides for a survey of *Osage River, Missouri*, from its mouth to the first shoal, and five miles above the same, and to report an estimate based on such survey of the cost of constructing one lock and dam within the limits of said survey, and the effect upon the navigation of said river of constructing said lock and dam. Major Miller was charged with this survey, the results of which will be submitted when received.

IMPROVEMENT OF THE MISSISSIPPI RIVER BETWEEN THE DES MOINES RAPIDS AND THE MOUTH OF THE ILLINOIS RIVER.

Officer in charge, Capt. E. H. Ruffner, Corps of Engineers. Division Engineer, Col. O. M. Poe, Corps of Engineers.

The general project consists in contracting the low-water bed of the river to an average width of 1,800 feet. All island chutes are to be closed by dams, and wing-dams and the river contracted where wider than the proposed channel. The works are generally built of brush and rock. Piling is occasionally used. Dredging has been done to remove the sand from the crossings of the worst bars. Work under the present appropriation has been done at Alexandria, Mo., Canton and

Smoot Chutes, Whitney's Bar, and the numerous islands some 4 miles above the mouth of the Illinois. Dredging was done near Hamburg. The hydraulic dredge was partially used during the fall of 1888. An allotment of the appropriation for the repair of the Sny Island Levee has been used for that purpose, and that levee is now in as good order as when the disaster occurred in May, 1888.

July 1, 1888, amount available.....	\$327. 05
Amount appropriated by act of August 11, 1888.....	200,000. 00
	<hr/> 200,327. 05

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$90,213. 05
July 1, 1889 outstanding liabilities.....	13,922. 17
July 1, 1889, amount covered by existing contracts.....	36,502. 68
	<hr/> 140,637. 90

July 1, 1889, balance available.....	59,689. 15
	<hr/> 300,000. 00

{ Amount that can be profitably expended in fiscal year ending June 30, 1889 300,000. 00
 { Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix Z 1.

EXAMINATION FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examination of *Clarksville Harbor, Missouri*, was made by the local engineer, Captain Ruffner, and harbor reported by him as worthy of improvement. This conclusion being concurred in by the Chief of Engineers, and the report of the result of the examination containing information sufficient to indicate to Congress the probable cost of the work required, no further report or survey appeared to be necessary. The improvement proposed is the construction of a dam to close chute between Clarksville Island and the Illinois shore, and the building of a wing-dam from the Illinois shore above the head of the island. Estimated cost, \$25,000. (See Appendix Z 2.)

IMPROVEMENT OF THE NAVIGATION OF THE MISSISSIPPI RIVER BETWEEN MINNEAPOLIS AND DES MOINES RAPIDS, INCLUDING IMPROVEMENTS AT SPECIAL LOCALITIES BETWEEN THOSE POINTS—OPERATING AND CARE OF THE DES MOINES RAPIDS CANAL.

Officer in charge, Maj. A. Mackenzie, Corps of Engineers. Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. *Operations of snag-boats and dredge-boats on Upper Mississippi River.*—At the beginning of the fiscal year there was available the sum of \$1,911.34, to which was added by act of August 11, 1888, the sum of \$25,000, making a total of \$26,911.34, all of which was expended during the year. In September and October and parts of July and August, 1888, and in May and a part of June, 1889, the snag-boat *General Barnard* was employed removing snags and other obstructions and assisting interests of navigation between Minneapolis and the mouth of the Missouri River.

The snag-boat *J. G. Parke* and dredge *Phoenix* were employed removing wrecks and deepening channels during portions of September, October, and November, 1888, and May and June, 1889.

The total amount expended for snag-boat service on the Upper Mississippi River, between Minneapolis and the mouth of the Missouri, to July 1, 1889, is \$549,640.

As a result of the work of the snag-boat during past years, accidents and damage from snags, wrecks, and other similar obstructions have become very rare.

By the river and harbor act of August 11, 1888, provision was made for operating snag-boats and dredge-boats on the Upper Mississippi River under an indefinite appropriation, the sum so expended not to exceed the amount appropriated in said act for such purposes. The clause of the act regulating the annual expenditure for snag-boats and dredge-boats on the Upper Mississippi River is as follows: "For operating snag-boats and dredge-boats on Upper Mississippi River, twenty-five thousand dollars."

July 1, 1888, amount available.....	\$1,911.34
Amount appropriated by act of August 11, 1888.....	25,000.00

26,911.34

July 1, 1889, amount expended during fiscal year.....	26,911.34
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(See Appendix A A 1.)

2. *Mississippi River from Minneapolis to Des Moines Rapids.*—Prior to August 11, 1888, this work was carried on under appropriation for "improving Mississippi River from St. Paul to Des Moines Rapids." The act of August 11, 1888, extended the upper limits of the district from St. Paul to Washington Avenue Bridge, Minneapolis.

Under this appropriation is carried on the improvement of through navigation. Work has been in progress under approved projects since 1878, and very favorable results have been secured, showing that with a continuance of the work under liberal appropriations the low water channel of the Mississippi between St. Paul and the Des Moines Rapids can be made comparatively safe, convenient, and permanent. The interests for which the improvement is being made are very large and important.

During the past year work has been carried on by days' labor and use of Government plant between St. Paul and Prescott, in vicinity of Fountain City, West Newton Bar, Crooked Slough, between Otter Island and Nauvoo, in vicinity of Winona, Pontoosac, and Rock Island Rapids; and, by contract, in vicinity of Fort Madison and between Fairport and Muscatine. Temporary work in deepening channels by dredging was carried on at numerous points. There has been expended to June 30, 1889, for the permanent improvement of through navigation, the sum of \$1,701,775.28, or \$3,235 per mile.

It is estimated that there can be expended to advantage during the fiscal year ending June 30, 1891, for the continuation of the improvement of the low-water channel of the Mississippi River from Minneapolis to Des Moines Rapids, the sum of \$1,000,000.

July 1, 1888, amount available	\$65,225.53
Received from sale of fuel	111.04
Amount appropriated by act of August 11, 1888.....	600,000.00

665,336.57

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....

of liabilities outstanding July 1, 1888.....	\$205,473.97
July 1, 1889, outstanding liabilities.....	4,746.49
July 1, 1889, amount covered by existing contracts.....	92,275.07

302,495.53

July 1, 1889, balance available.....

362,841.04

{ Amount that can be profitably expended in fiscal year ending June 30, 1891	1,000,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A A 2.)

3. *Des Moines Rapids, Mississippi River.*—This work was commenced in 1866. The adopted plan provided for the building of a closed canal 8 miles long and for cutting an open channel in the rock bed of the river over the remaining 4 miles of rapids. The canal was opened in August, 1877, though not fully completed, and has been in operation since that time.

During the past year the floating boom connecting outer canal-wall with upper draw-rest of Keokuk Bridge was constructed at a cost of \$13,500, leaving \$11,500 of the \$25,000 appropriated for the purpose to be applied toward carrying out the existing project. A small amount of rock above grade in the open canal above Nashville was removed and the raising of the walls at lower lock and the construction of sluice at Sandusky were commenced. The work remaining to be done to complete project is the completion of sluices at Price's and Lamallee's creeks and of the raising of the lock-walls at middle and lower locks, a small amount of rock excavation in the open channel, construction of an office building at lower lock, and a small amount of embankment paving.

There has been appropriated and allotted for this work the sum of \$4,552,950. The net cost to the United States has been to June 30, 1889, \$4,518,034.57.

July 1, 1888, amount available.....	\$25,240.16
Amount appropriated by act of August 11, 1888	35,000.00
	<hr/> 60,240.16

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$26,343.85
July 1, 1889, outstanding liabilities.....	710.18
July 1, 1889, amount covered by existing contracts.....	12,858.88
	<hr/> 39,912.91

July 1, 1889, balance available	20,327.25
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{ Amount (estimated) required for completion of existing project.....	22,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	22,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A A 3.)

4. *Operating and care of Des Moines Rapids Canal.*—During the past year the Des Moines Rapids Canal was open for navigation two hundred and forty-five days, during which time there passed through it one thousand and twenty-two steam-boats and two hundred and eighty-eight barges, carrying 22,880 passengers, 50,008 tons of merchandise, and 381,559 bushels of grain. There also passed through 118,508,045 feet B. M. of lumber, 26,333,320 feet of logs, 50,221,099 shingles, and 37,413,810 laths. The expenses of the year have been \$38,885.37, and the estimated expenses for the coming year are \$45,000.

The expenses of operating and care of the Des Moines Rapids Canal are provided for by an indefinite appropriation made by act of March 3, 1881.

(See Appendix A A 4.)

5. *Dry dock at the Des Moines Rapids Canal, Mississippi River.*—The approved project for this work provides for the building on the river side of the Des Moines Rapids Canal, above the middle lock, of a dry-dock 400 feet long and 100 feet wide, with gates giving an entrance into the canal 80 feet wide. The original estimate of cost was \$125,000, which amount has been appropriated by Congress. There have been expended to date \$122,992.55, leaving an available balance of \$2,007.45, which is sufficient to complete the work at an early day.

The large plant owned by the United States and the entire commerce of the Upper Mississippi River will be benefited by this improvement.

Amount appropriated by act of August 11, 1888	\$16,250.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$14,017.55
July 1, 1889, outstanding liabilities	225.00
	<hr/> 14,242.55
July 1, 1889, balance available	2,007.45
(See Appendix A A 5.)	

6. *Harbor of refuge on Lake Pepin, at Stockholm, Wisconsin.*—On the breaking up of the ice in the spring of 1888, which occurred at high water and in a violent storm, the breakwater was much damaged. It was decided to rebuild the pier with sloping sides, which work was begun August 23 and completed early in November, 1888. The amount expended on this work to July 1, 1889, is \$24,860.53.

July 1, 1888, amount available	\$5,929.06
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding June 30, 1888	5,789.59
	<hr/> 139.47
July 1, 1889, balance available	
(See Appendix A A 6.)	

EXAMINATIONS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examinations of the following localities were made by the local engineer in charge, Major Mackenzie, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers concurring in the conclusions reached in these instances, has given no instructions to make further survey with the view to their improvement:

1. *Malone City Harbor, Illinois.*—(See Appendix A A 7.)
2. *Mississippi River, the main slough at Hamilton, Illinois, to the end of securing a good and sufficient steam-boat landing at that point.*—(See Appendix A A 8.)
3. *Mississippi River at and near the head of Beaver Island, at Clinton, Iowa, to determine what is necessary to remove the sand-bars there formed and forming, so as to make navigable and protect the entrance to the western channel, and the channel itself that runs between Beaver Island and the Iowa shore.*—(See Appendix A A 9.)

IMPROVEMENT OF THE MISSISSIPPI RIVER ABOVE THE FALLS OF ST. ANTHONY—IMPROVEMENT OF CHIPPEWA AND ST. CROIX RIVERS, WISCONSIN; OF MINNESOTA RIVER, MINNESOTA, AND OF RED RIVER OF THE NORTH, MINNESOTA AND DAKOTA—RESERVOIRS AT THE SOURCES OF THE MISSISSIPPI—IMPROVEMENT OF YELLOWSTONE RIVER, MONTANA AND DAKOTA.

Officers in charge, Maj. Charles J. Allen, Corps of Engineers, with Lieut. W. E. Craigbill, Corps of Engineers, under his immediate orders since April 9, 1889. Division Engineer since December 3, 1888, Col. O. M. Poe, Corps of Engineers.

1. *Mississippi River above Falls of St. Anthony, Minnesota.*—The present project, adopted in 1880, consists in improvement of the river between Aitken and Grand Rapids, a distance of 165 miles, by removal of

snags, boulders, bars, and leaning trees from the channels, and construction of wing dams, when necessary, to afford 3 feet depth during low-water stage, the cost being estimated at \$54,127. Under the appropriations of 1880-'81 and '82, the river between the points named was well cleared of large numbers of obstructions. But, between 1884 and 1888, and during the flood of the latter year, large numbers of snags and overhanging trees were formed. The appropriation, \$10,000, by the act of August 11, 1888, was applied to removal of obstructions, and by the close of the fiscal year the improvement had been carried to a point about half way between Grand Rapids and Aitken, and, in addition, a number of boulders were removed to within 20 miles of the latter point.

Total expended to June 30, 1888, \$35,000.

Total expended during the fiscal year ending June 30, 1889, including outstanding liabilities, \$8,668.17.

Before improvement commenced in 1880 the stream between Aitken and Grand Rapids was so obstructed that navigation was difficult and at times almost impossible for steamers of lightest draught. There is now a general depth in the improved channels of 3 feet at low water, but there are many snags, leaning trees, boulders, and masses of gravel yet remaining to be removed, as they contract the channels and thus interfere with the movement of steamers at any stage of water.

Several steamers navigate this portion of the Mississippi, carrying passengers and freight to the settlements, and supplies for lumber camps.

The sum of \$18,000, estimated for the fiscal year ending June 30, 1891, is for completion of the improvement between Aitken and Grand Rapids. This estimate adds \$8,872.50 to the original estimate.

July 1, 1888, amount available, including that for outstanding liabilities (\$3.67)	\$3. 67
Amount appropriated by act of August 11, 1888	10, 000. 00
	<hr/> 10, 003. 67
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$7, 610. 31
July 1, 1889, outstanding liabilities	1, 057. 86
	<hr/> 8, 668. 17
July 1, 1889, balance available	1, 335. 50
	<hr/>
{ Amount (estimated) required for completion of existing project	\$18, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	18, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867	

(See Appendix B B 1.)

2. *Reservoirs at headwaters of the Mississippi River.*—The object of the reservoirs is to collect surplus water, principally from the precipitation of winter, spring, and early summer, to be systematically released so as to benefit navigation upon the Mississippi River below the dams. The reservoir project is the outcome of surveys and examinations made in 1869, 1874, 1878, and 1879. From the results of these examinations, and further examinations made in 1880, the first cost of constructing reservoir dams in Minnesota and Wisconsin was placed at \$1,809,083. The cost of land and other damages to result from construction and operation of the proposed dams was not included in that estimate, as they could not be predicted with any approach to accuracy.

The present project consists in constructing reservoir dams at the headwaters of the Mississippi River in Minnesota, that locality having

been selected for commencing the work in consequence of an appropriation made by the river and harbor act approved June 14, 1880, for construction of a reservoir dam at Lake Winnibigoshish, Minnesota, and for other reasons, given in Appendix Y to the annual report for 1886. By 1886, four of the reservoirs had been created.

Expended upon this work, to the close of the fiscal year ending June 30, 1888, including examinations at proposed dam-sites, hydrological observations, land damages, amounts set aside as awards to Indians, and care and maintenance of the works, \$596,800.27.

The reservoirs were operated, 1885-1888, during the seasons of low water, to the benefit of navigation on more than 200 miles of the Mississippi River, viz: Between Grand Rapids and Aitken, 165 miles, and from St. Paul to some distance below the confluence of the Mississippi and St. Croix rivers.

Expended during the year ending June 30, 1889, in care and maintenance of the works, and increasing the capacity of the Pokegama Reservoir, \$14,673.26.

During the past spring, and to the close of June, the reservoirs maintained a boating stage on the Mississippi River between Grand Rapids and Aitken, the river between those points having received but little rainfall.

The sum of \$80,000 (estimated) for the fiscal year ending June 30, 1891, is to be expended in care and maintenance of the reservoir dams and dikes, in creating a reservoir at Sandy Lake, in connecting the three reservoirs above Grand Rapids by telephone, in constructing a line of telegraph from the Pokegama Reservoir to Aitken, and in operating and maintaining the line.

July 1, 1888, amount available.....	\$25,699.73
Amount appropriated by act of August 11, 1888.....	12,000.00
	<hr/> 37,699.73

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$12,318.35
July 1, 1889, outstanding liabilities.....	2,354.91
	<hr/> 14,673.26

July 1, 1889, balance available	23,026.47
	<hr/>

{ Amount (estimated) required for completion of existing project.....	1,174,583.50
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	80,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B B 2.)

3. *Chippewa River, including Yellow Banks, Wisconsin.*—The plan for improvement of the Chippewa River consists in revetment of caving bends and construction of dams and jetties from Eau Claire to the confluence of the Chippewa and Mississippi, a distance of 57 miles, to confine the low-water volume to a channel of nearly uniform width and depth. The general plan was adopted in 1877, and the work has been carried on in accordance with it, varying, however, more or less, as to location and extent of dams, jetties, etc. The protection of the Yellow Banks consists in a revetment of piling and fascines, the latter to be crowned with rock. The object of the Yellow Banks protection is to prevent their erosion, and thus to relieve the channels of the Chippewa River and of the Mississippi below the junction of the two streams from the masses of sand contributed by those banks. The plan for protecting the banks was adopted in 1883. The improvement of the river and the protection

of the Yellow Banks were regarded as separate and distinct works until the act of August 11, 1888. Estimated cost of the consolidated improvement, including all expenses from the commencement, \$272,487.72.

Expended to the close of the fiscal year ending June 30, 1888, as follows:

On improvement of the Chippewa River.....	\$115,712.72
On protection of Yellow Banks.....	30,000.00
Total.....	145,712.72

Before the improvement commenced the depth on the bars at low water seldom exceeded 18 inches, and the crossing at the mouth of the river was extremely difficult at that stage, owing to the volume of the river joining the Mississippi through a number of channels of insufficient depth. These latter-named channels were contracted into one of good depth by means of long parallel jetties. Generally, wherever works for improvement were constructed by the Government the low-water depths were increased from 18 inches to 3 to 4 feet. And the general improvement not only greatly facilitated the passage of steamers and rafts, but also greatly reduced the expense of rafting manufactured lumber.

Expended during the year ending June 30, 1889, \$8,622.21.

The work for the year consisted in construction of a long wing dam at Plum Island Flats, and in extensions of and repairs to existing dams, and in repairs of Yellow Banks protection. The effect of the work done at Plum Island Flats was to increase the original low-water depth of 18 inches to 3 feet.

The sum of \$30,000, estimated for the fiscal year ending June 30, 1891, is for constructing and completing dams and revetments between the Dells at Eau Claire and the mouth of the river, and for further protection of the Yellow Banks.

July 1, 1888, amount available	\$1,037.28
Amount appropriated by act of August 11, 1888	10,000.00
	11,037.28
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$3,377.21
July 1, 1889, outstanding liabilities.....	245.00
	8,622.21

July 1, 1889, balance available.....	2,415.07
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{ Amount (estimated) required for completion of existing project.....	115,737.72
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	30,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B B 3.)

4. *St. Croix River, Wisconsin and Minnesota.*—The original project for improvement, adopted in 1878, was based upon a survey made in 1874 when the river was at a high stage of water and but comparatively few obstructions to be seen. It contemplated removal of snags, bowlders, sand-bars, etc., and contraction of the low-water channels from Taylor's Falls to the confluence of the river with the Mississippi into one of nearly uniform width. Estimated cost \$21,758. At low-water, however, the channel had in many places but 2 feet of depth, and steamers and barges made their way as best they could amongst the obstructions; at times it was impossible for them to get over the shoal places. The present project, adopted in 1880, and modified as to cost in 1882, is based upon a low-water survey made in 1879, and differs

from that originally adopted only in amount of work to be done. Estimated cost, \$83,450.

Expended under original and present projects to the close of the fiscal year ending June 30, 1888, \$82,362.32. The work performed to that date resulted in a least depth of 3 feet on the improved bars above Stillwater and 4 to 5 feet on the bars below that place.

Expended during the past fiscal year, \$9,734.43. The work of the past year consisted in removing obstructions between Taylor's Falls and the mouth of the river, in constructing a wing-dam at Hudson Bar, and in dredging at the same locality, and in extending the wing-dam at Catfish Bar. These bars are below Stillwater, and before improvement was undertaken were formidable obstructions at low-water to the large raft and steam-boat navigation of the river. They now afford sufficient depth for the largest Mississippi River steamers which ascend to Stillwater, but the Hudson Bar Channel should be widened by dredging, and the channels at both bars be maintained by increase in wing-dams. Some bars above Stillwater yet require improvement, and obstructions, as snags, sunken logs, wrecks, etc., should be removed as they occur. Generally, it may be said of this improvement that at many points navigation has been rendered permanent where formerly it was uncertain, and that in other places it has been made practicable where, before improvement, it was impossible.

The sum of \$20,000, asked for the fiscal year ending June 30, 1891, is to be expended at Hudson and Catfish bars, below Stillwater, in improving several bars above the latter, and in general removal of obstructions and maintenance of existing works.

July 1, 1888, amount available	\$137. 68
Amount appropriated by act of August 11, 1888.....	10,000. 00
	<hr/> 10, 137. 68
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$9,692. 11
July 1, 1889, outstanding liabilities.....	42. 32
	<hr/> 9, 734. 43
July 1, 1889, balance available.....	403. 25
	<hr/>
(Amount (estimated) required for completion of existing project.....	34,200. 00
(Amount that can be profitably expended in fiscal year ending June 30, 1891	20,000. 00
(Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix B B 4.)	

5. *Minnesota River, Minnesota.*—From 1867 to 1873, inclusive, Congress appropriated \$77,500 for improving the Minnesota River. The appropriations were applied to removing snags and bowlders, so as to afford a least depth at low-water stage of 2 to 3 feet. In 1874 a survey was made from the mouth of the river to South Bend, a distance of about 116 miles, to determine the practicability of improving the navigation by means of canals, locks, and dams. Based upon this survey, estimates were made for five locks and dams and removal of snags, etc., at a cost of \$733,868.63, the cost of removing snags, etc., being therein placed at \$34,585.10, including contingencies. Following this report, Congress made three appropriations of \$10,000 each, by acts approved March 3, 1875, August 14, 1876, and June 18, 1878, which sums were applied to clearing the river of obstructions below South Bend.

Expended to June 30, 1879, \$117,467.

Since 1879 no work for improvement of the river has been undertaken. Under the appropriations above named the removal of obstruc-

tions cleared the way over long stretches of the river between Minnesota Falls and a point about 30 miles below Henderson. Little or no use was made of the improved channels, there being little or no steam-boat navigation of the river. The rapidly caving banks of the stream cause snags and leaning trees to form, so that channels which were cleared of them ten years ago are more or less encumbered with them to-day.

The river and harbor act of August 11, 1888, appropriated \$10,000 for improving the Minnesota River, including protection of the banks opposite the borough of Belle Plaine. It appearing from an examination made in September last that the sum was inadequate for the purposes named its expenditure for work for improvement was deferred until the further wishes of Congress in the matter might be known.

Total expended on the improvement to the close of the fiscal year ending June 30, 1888, \$117,467.

Expended during the year ending June 30, 1889, \$18.60.

July 1, 1888, amount available, including that for outstanding liabilities (\$9.00)		*\$42.00
Amount appropriated by act of August 11, 1888		10,000.00
		<hr/> 10,042.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$18.60	
July 1, 1889, outstanding liabilities	9.00	
		<hr/> 27.60
July 1, 1889, balance available		10,014.40

{ Amount (estimated) required for completion of existing project	693,868.63
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	25,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B B 5.)

6. *Red River of the North, Minnesota and Dakota.*—The project for the improvement of this river from Breckenridge to the northern boundary line, adopted in 1877, and amended as to cost in 1883, consists in the removal of snags, leaning trees, and bowlders, and in dredging channels through the bars, at an estimated cost of \$179,310. A revised estimate made in 1887 placed the cost of completing the improvement at \$179,598.37.

Expended upon this improvement, to the close of the fiscal year ending June 30, 1888, \$160,212.52, resulting in an improved channel, at high-water stage, due to removal of snags and overhanging trees, of 76 miles, between Fargo and Abercrombie; and an improved channel to afford 3 feet of depth at ordinarily low water for 80 miles north, by river, from Fargo; partially improved channels on Goose Rapids, 90 miles north from Fargo, due to removal of bowlders and dredging of bars; amelioration of navigation between Goose Rapids and Fargo by dredging, and 4 feet of depth at ordinary low water for 62 miles, by river, north of Grand Forks.

Before improvement the ruling depth upon bars between Moorhead and Goose Rapids, at ordinary low water, was but 1½ feet, and below Grand Forks 2 feet, while between Moorhead and Abercrombie the navigation was at all times difficult.

The improvement has largely increased the facilities for movement of grain by steam-boats and barges.

* Forty-two dollars, balance from former appropriations, deposited to credit of Treasurer of United States, November 11, 1885.

The work, during the fiscal year ending June 30, 1889, consisted in dredging on the lower half of Goose Rapids and in completing excavation of bars for 62 miles north of Grand Forks.

Expended during the past fiscal year \$13,552.56, resulting in 3-foot channels at ordinarily low water on the portion of rapids worked over, and betterment of the channels below Grand Forks for 62 miles.

Remaining to be done: Excavation of bars between Breckenridge and Fargo; from a point 10 miles above the rapids to the middle of the latter; a small amount of excavation from the foot of the rapids to a point 62 miles north of Grand Forks; dredging at the Pelican Bars, 115 miles north of the Forks, and removal of overhanging trees, snags, and boulders at a number of points.

The sum of \$40,000 estimated for the fiscal year ending June 30, 1891, to be applied, generally, towards completion of the improvement.

July 1, 1888, amount available	\$9,735. 13
Amount appropriated by act of August 11, 1888	20,000. 00

29,735. 13

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$11,679. 42
July 1, 1889, outstanding liabilities	1,873. 14

13,552. 56

July 1, 1889, balance available	16,182. 57
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{ Amount (estimated) required for completion of existing project.....	59,598. 37
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	40,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B B 6.)

7. *Surveys for reservoirs at the sources of the Mississippi, St. Croix, Chippewa, and Wisconsin Rivers.*—Nothing was done under this head during the past fiscal year, no funds having been available for such work.

{ Amount (estimated) required for completion of existing project	\$50,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B B 7.)

8. *Yellowstone River, Montana and Dakota.*—The project for improvement is to work down the river from Glendive, building wing-dams and dams to close island chutes where necessary in order to confine the water generally to one channel, and to thereby increase the depth on the rapids and shoal places; also, to remove rocks and boulders from the channels.

The original condition of the navigable channel was bad and unsafe, due to the existence of numerous swift rapids, to crooked and shallow channel at low water, and to the presence of rocks and loose boulders. By removing the latter at the worst places and by confining the water to one channel so as to increase the depth on the rapids, the river has been considerably improved for purposes of navigation. No work other than repairs to and care of the plant has been done since 1885, owing to insufficiency of funds. At present the stream is not navigated by steamers.

Expended to the close of the fiscal year ending June 30, 1889, \$106,808.29.

Expended during the fiscal year ending June 30, 1889, including outstanding liabilities, \$1,319.27.

July 1, 1888, amount available.....	\$13,260.98
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	1,319.27
July 1, 1889, balance available.....	11,941.71
{ Amount (estimated) required for completion of existing project.....	106,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	25,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix B B 8.)	

**EXAMINATION FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS
OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.**

The required preliminary examination of *Ice-harbor at or near Bismarck, Dakota, on the Upper Missouri River*, was made by the local engineer in charge, Major Allen, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers, concurring in the conclusion reached in this instance, has given no instructions to make further survey with the view to its improvement.—(See Appendix B B 9.)

**IMPROVEMENT OF TENNESSEE AND CUMBERLAND RIVERS, AND OF
CERTAIN RIVERS IN EASTERN TENNESSEE AND KENTUCKY.**

Officer in charge, Lieut. Col. J. W. Barlow, Corps of Engineers, with Lieut. H. E. Waterman, Corps of Engineers, under his immediate orders.

1. *Tennessee River.*—(a) *Above Chattanooga.*—The examinations of this section of the river in 1830 and 1871, show the principal obstructions to be reefs, gravel-bars, and a few snags, brought down by the annual floods, but that the bed and banks of the river are subject to only slight changes; improvements when made are therefore practically permanent.

The present project is to blast a channel through reefs, reduce sand and gravel bars, and to build up riprap dams to contract the waterway so as to obtain a safe navigable channel depth of 3 feet at low water.

The amount expended to June 30, 1888, was \$225,947.70, which has secured for commerce a lengthened season of navigation for steamboats, and an improved channel for the passage of rafts and flat-boats.

Of the forty-three obstructions work has been done upon at least twenty-nine of them, partially removing some and more or less improving others. A snag and tow boat was built for use upon the Tennessee and its tributaries.

In October last work was resumed at Soddy Shoals and continued at that point and White Creek Shoal until December.

The snag-boat *Weitzel* was employed in December in clearing the channel of snags, overhanging trees, etc., between Chattanooga and White Creek, about 114 miles.

Amount expended during fiscal year, including outstanding liabilities, was \$5,135.87.

July 1, 1888, amount available	\$52.30
Amount appropriated by act of August 11, 1888.....	15,000.00
	15,052.30
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$5,027.36
July 1, 1889, outstanding liabilities.....	63.40
	5,090.76
July 1, 1889, balance available	9,961.54

{	Amount (estimated) required for completion of existing project .. .	\$59,000.00
	Amount that can be profitably expended in fiscal year ending June 30, 1891	30,000.00
	Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C C 1.)

(b) *Below Chattanooga.*—The original condition of the section of the river from Chattanooga, Tenn., to Brown's Ferry, Ala., was found when examined in 1867, and subsequently, to be obstructed by reefs, bars, etc., and had about 3 feet of water in the channel for eight or nine months in each year. From Brown's Ferry to Florence it was not navigable, the Muscle Shoals forming an absolute barrier, excepting when the river was at an unusually high stage. From Florence to mouth of the river the usual surface obstructions were found, with many shoals, having deep water between them.

The present project consists in building around the Big Muscle Shoals a canal $14\frac{1}{2}$ miles long, 70 to 120 feet wide, and 6 feet deep, having nine locks, each 300 feet between gates and 60 feet wide, and an aqueduct over Shoal Creek 900 feet long, 60 feet wide, and 5 feet deep; in constructing a canal around the Elk River Shoals, $1\frac{1}{2}$ miles long, with two locks; and in blasting a channel through the bed-rock and building wing-dams at Little Muscle Shoals, a modification of the original plan for a system of lockage; and in improving the most troublesome places above Decatur and below Florence.

The total amount expended to June 30, 1888, including outstanding liabilities, is \$2,957,377.28, which has resulted in the improvement of the river, as follows:

The practical completion, as modified, of the Little Muscle Shoals, at a cost of about \$126,180, by cutting a channel through the bed-rock, $2\frac{1}{2}$ miles long, and building about 3 miles of stone dams. It is very probable that these dams will be modified in the future, or that locks will be built as originally projected and estimated for.

At Big Muscle Shoals and Elk River Shoals the eleven locks were built and miter-gates placed in position. The five lower locks are to have drop-gates, and one of these—at lock 5—was hung.

The aqueduct over Shoal Creek was erected, but considerable remained to be done to put it in an actually finished condition. Widening and straightening of canal-trunk was effected.

The permanent dams at Bluewater Creek and Six-Mile Creek and the Douglas Branch Bridge were constructed.

The dredge *Harwood* and its service dump-scows were built for use in dredging canal-trunk and its approaches.

The amount expended during the fiscal year, including outstanding indebtedness, was \$110,112.88, with the following results:

Three waste-weirs were constructed in the levels between locks 1 and 2, 3 and 4, and 5 and 6, respectively, to protect the tow-path, and a drift-sluice was placed at the head of lock 6 to carry off the drift, logs, etc., in times of flood.

At the Shoal Creek Aqueduct the masonry was cut to receive iron work to strengthen piers; braces and connecting-plates were put on, and iron work, etc., painted; a culvert was also built to drain the level above lock 7.

The break in the embankment above Lock A, caused by the heavy storms of January last, was closed by a permanent crib-dam filled with stone and clay, and the embankment raised.

The United States dredge *Harwood* was employed in dredging below Lock B, removing stone from cross-dam at Milton's Bluff, excavating

two cuts from cross-dam to and through first tow-head, etc.; slope-wall finished below Lock B; also, the culvert behind crib-work at Lock A.

Locks A and B are ready for use, with hand maneuvering appliances complete; but it is proposed to test at Lock A certain hydraulic machinery, as to efficiency and practicability for general use at each of the locks of the canal. This machinery will be built and tested early in the next fiscal year.

In April the United States steamer *Weitzel* passed through the two locks of the upper division, and six of the lower division, the gate machinery working very satisfactorily.

Work of channel excavation was begun at Nance's Reef at the close of the year.

The building of a small tug-boat for use in the canal-trunk was begun; the boat will be finished in July.

The United States snag-boat *Weitzel* was employed snagging during May; clearing the channel of snags in a stretch of river—119 miles—from 20 miles below Bridgeport to 6 miles below Decatur.

Sites for lock-keepers' houses and repair shops, etc., needed in operating and maintaining the canal, have been selected at the several locks, and necessary action is being taken to purchase the same, and procure cession of jurisdiction from the State of Alabama.

Straightening the upper channel entrance to the Elk River Shoals Canal, and raising the walls of Lock A to the level of its upper bay has been recommended and will be carried into execution during the next fiscal year.

The plans for the radical improvement of the Colbert Shoals and Bee Tree Shoals by locks and dams have been submitted, and the necessity of the work in connection with the opening of the Muscle Shoals Canal is urgently recommended.

Attention is also invited to the pressing need of improvements at the several obstructions existing in the mountain gorge immediately below Chattanooga, and commonly known as the "Suck," requiring the removal of large bowlders, gravel-bars, and projecting shore points.

July 1, 1888, amount available.....	622.72
Amount appropriated by act of August 11, 1888.....	250,000.00
	<hr/> 250,622.72
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$80,341.01
July 1, 1889, outstanding liabilities.....	26,392.22
	<hr/> 106,733.23
July 1, 1889, balance available.....	143,889.49
	<hr/>
{ Amount (estimated) required for completion of existing project.....	1,848,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891.....	1,000,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix C O 1.)	

2. *French Broad River, Tennessee.*—This river has a course in Tennessee of about 121 miles. It joins the Holston about 5 miles above Knoxville, thus forming the Tennessee.

Examinations were made in 1871 and 1875. The obstructions were of the character of those usually found in mountain streams—rock-reefs, gravel and sand bars, snags, etc.

The present project consists in removing surface obstructions, reducing ledges and bars, building wing-dams to contract the water-way,

where necessary, so as to obtain a channel depth of 2½ feet at ordinary low water to Leadvale, about 90 miles from mouth of river.

Above the mouth of Nolichucky River (Leadvale) to the boundary line of Tennessee and North Carolina, a system of locks and dams is the only feasible means of navigation, but the amount of commerce does not warrant the heavy expenditure.

The total amount expended to June 30, 1888, was \$28,000, which has resulted in obtaining an improved channel, and an increased depth of from 6 to 10 inches over several of the worst obstructions.

During the fiscal year work was carried on at Seven Island Shoals by clearing the channel of bowlders, snags, etc., and reducing the velocity of the current by the construction of seven or more new dams and modifying old ones. The amount expended in this work, including outstanding liabilities, was \$6,646.61.

Amount appropriated by act of August 11, 1888.....	\$10,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$5,034.81
July 1, 1889, outstanding liabilities.....	1,567.36
	<hr/> 6,602.17
July 1, 1889, balance available.....	<hr/> 3,397.83

{ Amount (estimated) required for completion of existing project.....	112,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	20,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C C 2.)

3. *Hiccassee River, Tennessee.*—This stream is an affluent of the Tennessee, which it enters about 38 miles above Chattanooga, Tenn.

An examination was made in 1875, when it was found that the river was greatly obstructed by reefs, gravel-bars, snags, and overhanging trees.

The project provides for the reduction of the reefs and bars, the removal of surface obstructions, and the building of wing-dams to contract the water-way, so as to secure a navigable channel about 40 feet wide, and 2 feet deep at the average low-water stage, to head of navigation, Savannah Ford, about 43 miles.

The amount expended to June 30, 1888, was \$34,000, which has resulted in clearing and improving the channel in the lower river, by removing surface obstructions to a limited degree from time to time during twelve years from 1876 to 1888.

No expenditures were made during the fiscal year ending June 30, 1889.

Amount appropriated by act of August 11, 1888.....	\$1,000.00
July 1, 1889, outstanding liabilities.....	21.89
	<hr/> 978.11

{ Amount (estimated) required for completion of existing project.....	1,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	1,500.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C C 3.)

4. *Clinch River, Tennessee.*—This stream rises in Virginia, and is an affluent of the Tennessee River. It is about 400 miles long, 230 miles of which are in Tennessee.

An examination was made in 1875, when it was found to be obstructed by ledges, gravel-bars, snags, overhanging trees, and a narrow crooked channel in many places. The project for the improve-

ment of its course in Tennessee seeks to obtain a safe channel at ordinary low water of 2 feet depth to Clinton, 70 miles, and of 1½ feet from Clinton to Walker's Ferry (Haynes), about 75 miles. This to be accomplished by building wing-dams to contract the water-way, and to reduce ledges and bars, and remove surface obstructions sufficiently to pass rafts and flat-boats in safety on the sudden rises, or "rain tides," common during the season of navigation.

The engineer officer in charge urges the importance of legislative or executive action in the matter of the construction of fish-trap dams upon this stream, calling attention to their character as channel obstructions. These dams appear to be authorized under an act of the Tennessee legislature approved April 2, 1885.

The amount expended to June 30, 1888, was \$25,958.09, which resulted in securing an improved channel at many of the principal obstructions, and safer navigation for rafts and flat-boats at lower stages of the river than before channel work was begun in 1880.

The amount expended during fiscal year ending June 30, 1889, was \$4,275.82, resulting in clearing the channel from Walker's Ferry to Lew Allen Shoals of surface obstructions; in widening the channel 20 feet at Kirkpatrick Shoals and Moses Rock. The strengthening of the old dams, and the construction of the new dams at Lew Allen Shoals will materially reduce the velocity of the current and deepen the channel at that obstruction.

July 1, 1888, amount available.....	\$41. 91
Amount appropriated by act of August 11, 1888.....	5,000. 00
	<hr/> 5,041. 91
July 1, 1889, amount expended during fiscal year exclusive of liabilities outstanding July 1, 1888	\$3,589. 98
July 1, 1889, outstanding liabilities.....	615. 00
	<hr/> 4,204. 96
July 1, 1889, balance available	836. 93
	<hr/>
{ Amount (estimated) required for completion of existing project.....	19,000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix C C 4.)	

5. *Cumberland River, Tennessee and Kentucky.*—(a) *Below Nashville.*—This river was examined in 1871, and the obstructions were found to be of the same general character throughout its course, consisting of ledges, gravel and sand bars, bowlders, snags, overhanging trees, and rapid currents.

The project for improving this section consists in deepening and widening the channel, removing surface obstructions, and building riprap dams where necessary to contract the water-way; and to remove the bar at mouth of the river and secure a navigable channel at low water along the Kentucky chute of the Ohio to the deep water of that river.

The total amount expended to June 30, 1888, was \$254,858.35, which was disbursed in removing surface obstructions, reducing gravel and sand bars, blasting a channel through reefs, and building riprap dams to contract the water-way sufficiently to obtain additional channel-depth at the most dangerous obstructions, and thus securing a lengthened season of navigation.

Amount expended during fiscal year was \$1,732.98. No work was carried on in the channel, the stage of water not being favorable.

Bench-marks were established to aid in determining uniform high-water grade lines upon the Cumberland and Tennessee rivers and tributaries. Payments for watching and caring for engineer property and current contingent expenses formed part of the expenditures.

July 1, 1888, amount available.....	\$141. 65
Amount appropriated by act of August 11, 1888.....	10, 000. 00
	<hr/> 10, 141. 65

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$1, 374. 49
July 1, 1889, outstanding liabilities.....	155. 06
	<hr/> 1, 529. 55

July 1, 1889, balance available	8, 612. 10
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{ Amount (estimated) required for completion of existing project	233, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	100, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C C 5.)

(b) *Above Nashville.*—The obstructions in this section are similar in character to those of the lower river.

The present project consists of a radical improvement by a system of locks and dams from Nashville to head of Smith's Shoals. The amount expended to June 30, 1888, was \$54,424.20, which has been applied to clearing the channel, repairing dams, etc., and in making necessary surveys, borings, current observations, estimates, and contingencies pertaining to the work of lock-construction; \$15,765.67, including outstanding liabilities, were expended during this fiscal year in purchasing lands for sites of lock-keepers' house and lock and dam No. 1. House was built by contract, and completed June 20. In September, contract was made for excavating lock-pit and part construction of lock. Under this contract about 800 linear feet of coffer-dam were built and 865 cubic yards of rock excavated from lock-pit; but unusually high water has greatly hindered operations. Contractor quarried and cut a few stones for the lock-walls.

The abutment for dam will be built by contract; bids to be opened August 6, 1889. The sites of lock and dam No. 2, near Beck's Ripple, about 14 miles above Nashville, having been approved, negotiations are in progress looking to the purchase of the lands. A line of levels was run from site of Lock 2 to head of Jones Island, the probable site of Lock 3.

A snagging party was fitted out to clear the channel. After repairing the dams at Sand Shoals and Walton's Shoals, the snag-boat moved down-stream from Walton's Shoals to mouth of Caney Fork River, clearing away the surface obstructions.

The engineer officer in charge suggests—for the reasons given in his report—that a lock and dam be built just below Burnside, Ky., thus carrying on the work at either end of the projected system of locks and dams.

July 1, 1888, amount available.....	\$70, 575. 80
Amount appropriated by act of August 11, 1888.....	200, 000. 00
	<hr/> 270, 575. 80

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$13, 746. 01
July 1, 1889, outstanding liabilities.....	1, 393. 20
July 1, 1889, amount covered by existing contracts.....	56, 543. 87
	<hr/> 71, 683. 08

July 1, 1889, balance available.....	198, 892. 72
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{ Amount (estimated) required for completion of existing project.	\$3,752,922.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891.....	400,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C C 5.)

6. *South Fork of Cumberland River, Kentucky.*—This stream is a tributary to the Cumberland River, which it joins near Burnside, Ky., about 325 miles above Nashville.

An examination was made in 1881, when it was found that the river was greatly obstructed in its upper course by immense bowlders, and in the lower section of 44 miles by rock-reefs and gravel-bars.

The project provides for improving the channel from Devil's Jumps to mouth of river, about 44 miles, by rock and gravel excavation, and building wing-dams, so as to secure safe navigation for flat-boats and rafts at a 3-foot stage above low water.

The amount expended to June 30, 1888, was \$11,968.94, which resulted in improving the lower river for the passage of rafts, etc., to a point about 16 miles above mouth of river.

No expenditures were made during the fiscal year ending June 30, 1889.

July 1, 1888, amount available.....	\$31.06
July 1, 1889, balance available.....	31.06

{ Amount (estimated) required for completion of existing project.....	50,803.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C C 6.)

7. *Caney Fork River, Tennessee.*—This stream, about 200 miles long, is an important affluent of the Cumberland River, which it enters near Carthage, Tenn., about 116 miles above Nashville. Its course is wholly in the State of Tennessee.

An examination was made in 1879 to Sligo Ford, about 72 miles, and in 1884 from that point to Frank's Ferry, about 20 miles.

The channel was found to be very crooked and greatly obstructed by bowlders, numerous gravel and sand bars, snags, overhanging trees, etc.

The project has in view to clear the channel of surface obstructions below Frank's Ferry, and to deepen and straighten the channel by building wing-dams and training-walls where necessary, so as to secure safe navigation for rafts and flat-boats, and for light-draught steam-boats during the boating season, usually five months, from February to July.

To June 30, 1888, the sum of \$19,421.95 was expended in clearing the channel from time to time of snags, drift, etc., brought down by the annual floods, and in reducing the bars, and building wing-dams at the worst shoals, which resulted in obtaining an improved channel below Sligo Ford when the river is at a stage not less than 3 feet above ordinary low-water mark.

Operations have been carried on only during the month of June, by snagging below Chandler's Islands, and quarrying stone for proposed dams at that point and near Trousdale's Ferry.

The amount expended during the fiscal year, including outstanding indebtedness, was \$1,054.72.

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July 1, 1888, amount available.....	\$578. 05
Amount appropriated by act of August 11, 1888	2, 500 00
	<hr/> 3, 078. 05
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$331. 53
July 1, 1889, outstanding liabilities.....	704. 19
	<hr/> 1, 035. 72
July 1, 1889, balance available.....	<hr/> 2, 042. 33
{ Amount (estimated) required for completion of existing project.....	22, 728. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	5, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix C C 7.)	

EXAMINATION AND SURVEY FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

It appearing from the report of the preliminary examination made by the local engineer of *Lower Cumberland River from Nashville, Tennessee, to mouth, to ascertain if necessary to establish locks and dams*, that the locality is worthy of improvement, and the public necessity therefor being apparent from the facts and reasons reported, which are concurred in by the Chief of Engineers, Lieutenant-Colonel Barlow was charged with its survey, the results of which will be submitted when received.

IMPROVEMENT OF THE OHIO, MONONGAHELA, MUSKINGUM, AND ALLEGHENY RIVERS.—OPERATING AND CARE OF DAVIS ISLAND LOCK AND DAM, OHIO RIVER; LOCK AND DAM NO. 9, MONONGAHELA RIVER, AND THE LOCKS AND DAMS ON THE MUSKINGUM RIVER, OHIO.—CONSTRUCTION OF ICE-HARBOR AT MOUTH OF MUSKINGUM RIVER, OHIO, AND OF LOCK AND DAM AT HERR'S ISLAND, ALLEGHENY RIVER.

Officer in charge, Lieut. Col. William E. Merrill, Corps of Engineers, having under his immediate orders First Lieuts. Lansing H. Beach and Cassius E. Gillette, Corps of Engineers.

1. *Ohio River*.—The general method followed in improving the navigation of the Ohio River is to secure additional depth at islands and sand-bars by the construction of low dams across unused passages, and by building guiding-dikes where the river is so wide and shoal as to make it necessary to confine the current to a smaller cross-section. A snag-boat and two dredges, all of them having iron hulls, are owned by the United States, and find constant employment in taking out snags and wrecks, and in dredging away gravel bars which can not be otherwise removed.

The first appropriation for the improvement of the Ohio River was made in 1827, and the total sum thus far appropriated exclusively for this river is \$4,756,479.25. In addition to these direct appropriations a portion of several combined appropriations for the Mississippi, Missouri, Ohio, and Arkansas rivers, aggregating \$1,997,040.68, has been allotted to the Ohio.

The following is a summary of the work done during the fiscal year.
Drift-gap at Davis Island movable dam.—Work on this drift-gap was begun in August, 1888, but a constant succession of rises prevented the completion of the structure before winter set in. During the winter the coffer-dam was broken, but it was repaired and work was resumed

in April, 1889. The coffer was again broken by the flood of the latter part of May, and owing to continued high water the repairs had not been fully completed at the close of the fiscal year.

Dam between Davis and Neville islands.—Work on this dam has been limited to the assembling of materials, the stage of water having been too high to permit any work of construction.

Dike at the trap.—Minor damages to this structure were repaired in August, 1888, and it is now in good order.

Dam at Marietta Island.—Work on the rebuilding of this dam was begun in May, 1889, but on account of high water nothing could be done beyond placing about 1,500 cubic yards of stone.

Dike at Eight-Mile Island.—Work on this dike was begun in May, 1889, and at the close of the fiscal year the crib-work had been built for a length of 150 feet from the shore end.

Dike at Bonanza Bar.—Work was begun in May, 1889, and at the close of the fiscal year the dike had been extended and partly completed for a length of 300 feet.

Dike at Madison, Indiana.—Work on this dike was begun in May, 1889, and at the close of the fiscal year the piling for the substructure had been driven for a length of 200 feet from the shore, and about 400 cords of brush put in place.

Dike at Caseyville, Kentucky.—Work was begun in May, 1889, and at the close of the fiscal year the dike had been extended, but not completed, for a length of 150 feet from the shore.

Dike at Middle of Grand Chain.—During the year the stage of the water was such that only ten days' work could be done by the contractor. About 1,900 feet of the dike is finished out of 3,008 feet.

Ice-piers.—The inner section of the ice-pier at Pomeroy and both sections of the piers at Middleport have been completed except the sheeting of the up-stream slopes. The pier at Iron-ton has been completed. Work on the Portsmouth ice-pier has not yet been begun, owing to lack of cession of riparian rights.

Rock obstruction at mouth of Licking River.—Bids for removing this obstruction were opened on June 20, and the contract was awarded to the lowest bidder, John F. King, of Belpre, Ohio.

Improving channel of Big Hocking River.—On account of high water, which continued until the close of the fiscal year, work on this river has been impracticable. It will be undertaken as soon as the stage of water will permit.

Great Miami embankment.—The track of the Cincinnati, Indianapolis, St. Louis and Chicago Railway has been raised to 3 feet below the flood of 1884, from Hardentown to the Fair Grounds in Lawrenceburgh, Ind., and the allotment made by act of August 11, 1888, is to be expended in carrying the levee to the foot of Elm street, in that city.

Embankment at Shawneetown.—A contract has been made for the necessary earthwork, and at the close of the fiscal year about 8,600 cubic yards of earth had been put in place. A contract for paving will be made during the summer.

Rock reef at Brooklyn, Illinois.—Bids for the removal of this reef were opened on the 20th of June, and the contract was awarded to the lowest bidder, H. S. Brown, of Quincy, Ill.

Dredging.—During the year 1888, the United States dredges *Ohio* and *Oncego* worked on the Muskingum River till June 13, and on the Ohio River from September 24 to December 17. While at work on the Ohio River they removed 15,189 cubic yards at the foot of Blennerhassett's Island; 28,852 cubic yards of miscellaneous material, 15½ tons of rock,

and part of a wrecked bridge from Wheeling Bar; and 1,051 cubic yards from the mouth of the Muskingum. One of the dredges lifted the blockade at Brown's Island, in March, 1888, by destroying eight wrecked coal boats and barges. Work was greatly hindered by continuous high water.

Snagging.—The snag-boat *E. A. Woodruff* worked on the Ohio River in 1888 from September 13 to October 31, when she was temporarily transferred to the Mississippi. While at work on the Ohio she removed 329 snags and 24 wrecks.

The fiscal year was remarkable for the long continuance of navigable water, and the absence of very high water in the Ohio River, as is shown by the tables in the report of the officer in charge.

July 1, 1888, amount available.....	\$16, 202. 95
Amount appropriated by act of August 11, 1888	380, 000. 00
	<hr/> 396, 202. 95

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding and of amount covered by contracts July 1, 1888.....	\$58, 577. 45
July 1, 1889, outstanding liabilities.....	13, 779. 41
July 1, 1889, amount covered by existing contracts	137, 363. 83
	<hr/> 209, 720. 69

July 1, 1889, balance available.....	186, 482. 26
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Amount that can be profitably expended in fiscal year ending June 30, 1891. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	600, 000. 00
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(See Appendix D D 1.)

2. *Operating and care of Davis Island Dam, Ohio River.*—This dam was built to test the adaptability of the system of movable dams to the peculiar conditions of the Ohio River, and to the special character of the commerce that navigates it. It was intended, if successful, to be the first step in the radical improvement of the Ohio River designed to give a minimum depth of 6 feet at all times except when ice is running. Incidentally this dam has been of great value to the city of Pittsburgh, by securing an ample depth of water in its harbor throughout the low-water season.

The year just ended was remarkable for the steady continuance of navigable water throughout the year, and in consequence of this favorable condition the dam was only up during 57 days. During this time 352 lockages were made, passing 836 vessels.

During the year the operation of the lock was very satisfactory, and the only difficulty with the dam came from the bad condition of the steel cross-heads of the navigable pass. Nearly half of these have been replaced with wrought-iron cross-heads. The flood of July, 1888, carried away the bridge of weir 2, but this casualty did not interfere with the working of the dam.

After further study, the officer in charge decided that it was possible to work the dam during ice floods, by placing the maneuvering boat below the dam and pushing the wickets up-stream until the props were tripped, thus making it unnecessary to go to the expense of introducing Chanoine trippers.

Amount expended during the year, \$14,958.81; amount required for the fiscal year ending June 30, 1890, \$13,618.

(See Appendix D D 2.)

3. *Monongahela River, West Virginia and Pennsylvania.*—The object of the locks and dams which the United States is building on the Monongahela River is to extend the existing slackwater from the mouth of Dunkard Creek, Pennsylvania, to Morgantown, W. Va., a distance of 14 miles. Two locks and dams are required for this extension: No. 9, the upper, was completed in 1880; No. 8, the one next below, is in course of construction. When completed, these locks and dams will give 6 feet in low water from Morgantown to Dunkard Creek, whence there is already 4 feet to Pittsburgh, secured by seven locks and dams belonging to the Monongahela Navigation Company. The distance from Morgantown to Pittsburgh is 102 miles. At Pittsburgh the Monongahela slackwater connects with the pool of the Davis Island Dam.

The total amount heretofore appropriated for this improvement is \$432,900, of which sum \$361,572.68 has been expended to June 30, 1889.

During the past fiscal year the masonry of the lock and of the abutment has been completed, and the building of lock gates and establishment of machinery will be carried on while the dam is being built under a contract already made. It is expected that the whole work will be open to navigation by the close of 1889.

An estimate of \$25,000 is submitted for continuing the work of improvement.

July 1, 1888, amount available	\$49,861.97
Amount appropriated by act of August 11, 1888	35,000.00
	<hr/> 84,861.97

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$13,534.65
July 1, 1889, outstanding liabilities	703.97
July 1, 1889, amount covered by existing contracts	38,727.08
	<hr/> 52,965.70

July 1, 1889, balance available	31,896.27
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{ Amount that can be profitably expended in fiscal year ending June 30, 1891	25,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D D 3.)

4. *Operating and care of Lock and Dam No. 9, Monongahela River.*—During the past fiscal year the lower buttresses of the lock were raised to the height of the upper buttresses, and the chamber walls were partly raised; the corresponding changes in the lower lock-gates and in the discharging valves were also made. Both chamber walls were tightened by injecting liquid cement. All the Government buildings were washed away by the unprecedented flood of July, 1888.

During the present fiscal year it is proposed to finish the raising of the lock-walls and to make minor repairs and additions.

Amount expended during the fiscal year, \$8,804.10; amount required for year ending June 30, 1890, \$6,450.

(See Appendix D D 4.)

5. *Allegheny River, Pennsylvania.*—The work hitherto done on this river has been limited to the removal of rocks, of which there was a vast number in and near the channel, and to the closure at two localities of duplicate channels. The benefit of this work has been very apparent.

The money thus far appropriated for the improvement of the river amounts to \$160,000, of which \$136,895.92 has been expended to June 30, 1889.

No work other than surveys and the establishment of two water-gauges could be done during the past season on account of unusual high water. A contract has been made for a dike at Red Bank and two low dams are to be built at the Cornplanter Islands.

July 1, 1888, amount available	\$659. 33
Amount appropriated by act of August 11, 1888	25,000. 00

25,659. 33

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$2,555. 25
July 1, 1889, outstanding liabilities	270. 00
July 1, 1889, amount covered by existing contracts.....	13,783. 95

16,609. 20

July 1, 1889, balance available	9,050. 13
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{ Amount that can be profitably expended in fiscal year ending June 30, 1891	50,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D D 5.)

6. *Dam at Herr's Island, Allegheny River.*—The object of this dam is to extend navigable water up the Allegheny, from the head of the pool of the Davis Island Dam to the city limits, thus completing the improvement of the harbor of Pittsburgh, and providing the means for the cheap transfer of freights at all seasons. This dam will also be the first step towards the radical improvement of the Allegheny River, a work that promises most valuable results.

The construction of this lock and dam has not yet been begun from inability to procure the necessary land. Negotiations are still in progress.

The amount thus far appropriated for this purpose is \$72,500.

July 1, 1888, amount available	\$36,592. 00
Amount appropriated by act of August 11, 1888.....	35,000. 00

71,592. 00

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$360. 22
July 1, 1889, outstanding liabilities.....	30. 00

890. 22

July 1, 1889, balance available.....	70,701. 78
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{ Amount that can be profitably expended in fiscal year ending June 30, 1891	100,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D D 6.)

7. *Ice-harbor at mouth of Muskingum River, Ohio.*—The work in hand is the construction of a large lock through Dam No. 1, Muskingum River, in order to permit Ohio River craft to take refuge during ice floods in the pool created by this dam. This lock is also needed to replace Lock No. 1 of the Muskingum River, which has long been in a dangerous condition. The total amount thus far appropriated for this work is \$297,500, of which \$260,149.33 has been expended to June 30, 1889.

The season's work was a practical failure owing to the constant succession of rises in the Ohio River, which flooded the coffer-dam almost as rapidly as it could be pumped out. The work remains in practically the same condition as at the close of 1887.

July 1, 1888, amount available	\$1,162. 46
Amount appropriated by act of August 11, 1888	60,000. 00
	<hr/> 61,162. 46

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$23,811. 79
July 1, 1889, outstanding liabilities	1,730. 22
July 1, 1889, amount covered by existing contracts	947. 30
	<hr/> 26,449. 31

July 1, 1889, balance available	34,673. 15
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{ Amount (estimated) required for completion of existing project	15,000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	15,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D D 7.)

8. Muskingum River, Ohio.—The act of August 11, 1888, appropriated \$102,000 for building a new lock at Taylorsville, and for changing the flight of two locks at Zanesville into a single lock.

A contract has been let for the Taylorsville lock, and work was begun in June, 1889; nothing has been done towards changing the Zanesville lock, and the engineer officer in charge recommends that this matter be held in abeyance.

Amount appropriated by act of August 11, 1888	\$102,000. 00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	183. 25
July 1, 1889, outstanding liabilities	136. 00
July 1, 1889, amount covered by existing contracts	61,340. 62
	<hr/> 61,659. 87

July 1, 1889, balance available	40,340. 13
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(See Appendix D D 8.)

9. Operating and care of the locks and dams on the Muskingum River, Ohio.—As originally improved by the State of Ohio, the Muskingum River contained eleven dams and twelve locks, and furnished continuous navigation for 91 miles from the Ohio River at Marietta to Dresden, at which place a connection was made with the Ohio Canal near its middle point, the canal extending from the Ohio River at Portsmouth to Lake Erie at Cleveland. According to old reports from the State Board of Public Works the locks were built 180 feet long and 36 feet wide, except the lock between Zanesville and Dresden, which was 120 feet long and 22 feet wide. The lifts of the locks are reported to have varied from 8 feet 10 inches to 12 feet 1 inch, and the whole cost of construction was about \$1,500,000.

The lock and dam above Zanesville is now destroyed, but the 75 miles of slackwater between Zanesville and the Ohio River has been maintained in good navigable condition; on this piece of river there are ten dams, eleven locks, and five lateral canals with a total length of 3½ miles.

During the first half of the fiscal year the river remained so high that many needed repairs could not be made. A new abutment inside of the old one was built at the Beverly Dam, and 100 feet of this dam was rebuilt. In May, 1889, navigation was stopped, and at the close of the fiscal year four locks were being rebuilt, one new abutment was under way and preparations had been made for extensive repairs on two dams. A line of exact levels was run over the whole length of improved river, and it was connected with the Coast Survey Trans-Continental line.

The new ladder dredge was received from the contractors and put to work; a boat-yard was started at McConnellsville, and a number of lock gates and barges were built. The officer in charge appends a table showing the exact dimensions of the locks and dams and the heights of the main structures above mean ocean level.

Amount expended during the fiscal year, \$128,521.44. Amount required for year ending June 30, 1890, \$221,948.

(See Appendix D D 9.)

EXAMINATIONS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examination of *harbor at Owensborough, Ky.*, was made by the local engineer in charge, Lieutenant-Colonel Merrill, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers, concurring in the conclusion reached in this instance, has given no instructions to make further survey with the view to its improvement. (See Appendix D D 10.)

At the following localities, reported by the local engineer as worthy of improvement, and this conclusion being concurred in by the Chief of Engineers, the result of the preliminary examination containing information sufficient to indicate to Congress the probable cost of the work required, no further report or survey appeared to be necessary:

1. *Monongahela River, above upper dam, West Virginia.*—The improvement proposed is the construction of six additional locks and dams on this stream, extending the slackwater navigation from Morgantown to several miles above Fremont, to reach the heavy deposits of coal on the West Fork. Estimated cost, \$1,200,000. (See Appendix D D 11.)

2. *Cheat River, West Virginia.*—The estimated cost of such work as is immediately necessary on this river is \$13,000, all of which could be advantageously expended in blasting and removing rock from the stream. (See Appendix D D 12.)

3. *Muskingum River, Ohio, from Zanesville to Dresden.*—The improvement proposed is the building of a new lock and dam, at an estimated cost of \$139,000. (See Appendix D D 13.)

IMPROVEMENT OF THE FALLS OF THE OHIO AND OPERATING AND CARE OF THE LOUISVILLE AND PORTLAND CANAL. IMPROVEMENT OF WABASH RIVER, INDIANA AND ILLINOIS, AND OF WHITE RIVER, INDIANA.

Officer in charge, Maj. Amos Stickney, Corps of Engineers. Division Engineer, Col. O. M. Poe, Corps of Engineers

1. *Falls of the Ohio, Louisville, Kentucky.*—By the river and harbor act approved August 5, 1886, this work, which originally consisted of the enlargement of the upper part of the Louisville and Portland Canal, was made to include the enlargement of the canal basin just above the new locks.

Enlargement of the upper portion of the Louisville and Portland Canal.—The present project was adopted in 1883. It has for its object the enlargement of the upper end of the Louisville and Portland Canal, from a point about 400 feet below the railroad bridge to the upper end of the rock ledge which extends to a point about opposite Fourth street. The improvement practically makes a harbor from Tenth street east, and more than doubles the width of the canal from Tenth to Fifteenth street.

The work has heretofore been done under four contracts, three for excavating and removing materials and one for the construction of part of the new canal wall along the northern line of the improvement from Tenth street west. One of the contracts for excavation was completed in November, 1886. The other two contracts for excavation expired December 31, 1888, leaving on one about 20 per cent. and on the other about 68 per cent. of the rock excavation to be done.

The contractors for the new canal wall have completed about 87 per cent. of their work.

The officer in charge has been authorized to purchase a plant and finish the excavation work by hired labor. The greater part of this plant has been purchased, and the work will begin when the river reaches a favorable stage.

An agreement has been made with Mr. J. B. Speed for the transportation of the excavated material after it is loaded in cars.

The amount expended to June 30, 1889, was \$299,394.54.

Enlarging basin of canal above new locks.—This work has heretofore been carried on under contract with Gleason & Gosnell. The time for completion, after several extensions, expired December 1, 1888, and the officer in charge was authorized to purchase a plant and finish the work by hired labor. The plant is now in place and active operations will begin as soon as the stage of the river will permit.

The amount expended to June 30, 1889, was \$30,345.66.

July 1, 1888, amount available	\$18,447.05
Add amount covered by contracts July 1, 1888	140,048.41
Amount appropriated by act of August 11, 1888	150,000.00

308,495.46

July 1, 1889, amount expended during fiscal year, exclusive of	
liabilities outstanding July 1, 1888	\$38,235.66
July 1, 1889, outstanding liabilities	17,606.65
July 1, 1889, amount covered by existing contracts	11,194.42
	<hr/> 67,036.73

July 1, 1889, balance available	241,458.73
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{ Amount (estimated) required for completion of existing project	855,363.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	300,000.00
{ Submitted in compliance with requirements of sections 2 of river and	
{ harbor acts of 1866 and 1867.	
(See Appendix E E 1.)	

2. *Indiana Chute, Falls of the Ohio River.*—The present project is to remove projecting points and reefs in the chute between the cross-dam and railroad bridge, so as to produce a straight and unobstructed channel 400 feet wide, and to raise the guiding-dike, which extends along the north side of the chute from the cross-dam 500 feet west. The chute was originally very crooked and full of dangerous reefs and points. The work already done has resulted in an unobstructed channel 250 feet wide.

No work was done on this improvement during the past year on account of the high stage of the river.

The amount expended to June 30, 1889, was \$116,043.30.

A more definite project for greatly improving this channel and making it available at lower stages of the river and relieving the Louisville and Portland Canal is now being considered by a board of officers of the Corps of Engineers.

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July 1, 1888, amount available.....	\$9,412.44
Amount appropriated by act of August 11, 1888.....	15,000.00
	<hr/> 24,412.44
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$455.74
July 1, 1889, outstanding liabilities.....	10.50
	<hr/> 466.24
July 1, 1889, balance available.....	<hr/> 23,946.20
<hr/>	
{ Amount (estimated) required for completion of existing project.....	115,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	75,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix E E 2.)	

3. *Operating and care of Louisville and Portland Canal.*—During the fiscal year the canal was open for the passage of commerce, with the exception of 46 days. It was closed 42 days on account of high water and 4 days on account of the sinking of a loaded coal-boat in the lower lock, which had to be dredged out. During the year 6,838 vessels, representing an undertonnage of 1,815,986 tons, were passed through the canal.

Work on the revetment slopes at the locks, which was done under contract, has been completed with the exception of 861 square yards. It is proposed to carry this revetment around the point at the lower end of the locks to protect the lower engine-house, and to give a proper finish to the work. A drilling scow has been built and fitted with steam drills, to be used in the excavations of the channel just below the locks. The dredges, with steam-boat tender have been employed in removing mud deposited in the canal; 82,000 cubic yards of this material have been removed; the dry-dock was used 62 days for repairs to other than Government vessels. New floors have been put on two of the bridges across the canal. Necessary repairs have been made to lock machinery and operating plant. It is proposed during the coming year to replace the middle gates of the new locks, and prepare for the renewal of the guard-gates of both the old and new locks if it should become necessary; to excavate the channel below the locks; to build two new mud-scows, and to have the city's water-pipes extended to the locks to supply water for the use of employes.

The total receipts from all sources amount to \$1,010.89. The estimated amount required for operating and maintaining the canal during 1889-'90 is \$94,660.

(See Appendix E E 3.)

4. *Wabash River, Indiana and Illinois.*—This river has been separated into two portions with reference to its improvement, Vincennes, Ind., being the dividing point, and appropriations have been made for each division.

Below Vincennes.—The first appropriation for the improvement of this river was made in 1872. The present project is the removal of rock ledges, sand-bars, snags, and other obstructions, and the closing of chutes, with a view to obtaining a navigable channel of 3½ feet depth from the mouth of the river to Vincennes, and the construction of a lock and dam at Grand Rapids, near Mount Carmel.

In the beginning of the year the contractor for furnishing stone for the lock at Grand Rapids failed, and it was necessary to make purchases of stone in open market. Work was begun July 7, 1888, and carried on, with numerous interruptions on account of high water and

lack of stone, until November 10, when it was suspended for the season. The stone purchased in open market was from the Salem Stone and Lime Company, and they were also awarded a contract for a further supply on April 23, 1889. Work on the lock will be resumed as soon as the stage of the river will permit. A low dam of loose stone was placed across a number of low places beyond the end of the Grayville levee, to prevent a cut being made by flood water. The levee is in good condition, but it is proposed during the coming season to place sloping spur-dikes in the upper bend to prevent the cutting away of the river bank at the narrow part of the neck upon which the levee stands.

The snag-boat was in operation as long as the limited amount of funds would permit, accomplishing good results.

Work is contemplated during the next low-water season in the rock shoal between Mount Carmel and Grand Rapids. This shoal is a barrier to low-water navigation and has caused great expense and delay in getting material to the lock.

Amount expended to June 30, 1889, \$195,023.77.

July 1, 1888, amount available.....	\$9,698.90
Add amount covered by contracts July 1, 1888.....	10,365.77
Amount appropriated by act of August 11, 1888.....	60,000.00
	<hr/> 80,064.67

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$35,084.63
July 1, 1889, outstanding liabilities.....	4,746.47
July 1, 1889, amount covered by existing contracts.....	11,219.41
	<hr/> 51,050.51

July 1, 1889, balance available.....	<hr/> 29,014.16
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{ Amount (estimated) required for completion of existing project.....	221,600.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891.....	100,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix E E 4.)

Above Vincennes.—The project for the improvement of this part of the river was the removal of snags and other obstructions, and the construction of wing-dams where necessary. During the fiscal year ending June 30, 1889, snagging operations were carried on from September 25 to December 29, 1888, when the work was stopped on account of the exhaustion of funds. This work was of great service to navigation, but will have to be continued to materially benefit the commerce of the river.

The amount expended on this river above Vincennes to June 30, 1889, was \$70,748.22.

July 1, 1888, amount available.....	\$60.03
Amount appropriated by act of August 11, 1888.....	5,000.00
	<hr/> 5,060.03

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$4,808.25
July 1, 1889, outstanding liabilities.....	6.85
	<hr/> 4,815.10

July 1, 1889, balance available.....	<hr/> 244.93
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{ Amount (estimated) required for completion of existing project.....	20,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891.....	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix E E 4.)

5. *White River, Indiana.*—The project for the improvement of this river has for its object the obtaining of a depth of $3\frac{1}{2}$ feet at low water between the mouth and the railroad bridge above Hazleton. The principal obstruction has been a rock ledge, known as Kelly's Ripple, through which a cut 2,250 feet long and 75 feet wide has been made, the excavated material being used for dikes on the sides of the channel. The work of the past year has been directed to removing the previously blasted rock from the channel, and has amounted to 7,835 cubic yards, which finishes the cut to a width of 75 feet.

The bridge above Hazleton continues to obstruct navigation, and no improvement above that point is at present contemplated. The railroad company operating the bridge have been notified to make such changes as will permit free and easy navigation. They have also been notified to change the bridge across the river, about one-half mile above its forks.

The amount expended on White River to June 30, 1889, was \$102,272.48.

July 1, 1888, amount available.....	\$2,348.26
Amount appropriated by act of August 11, 1888.....	5,000.00
	<hr/> 7,348.26
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$2,120.74
July 1, 1889, outstanding liabilities.....	3.75
	<hr/> 2,124.49
July 1, 1889, balance available.....	5,223.77
{ Amount (estimated) required for completion of existing project.....	12,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix E E 5.)	

IMPROVEMENT OF GREAT KANAWHA, ELK, AND GAULEY RIVERS, WEST VIRGINIA, AND IMPROVEMENT OF NEW RIVER IN VIRGINIA AND WEST VIRGINIA.

Officer in charge, Col. William P. Craighill, Corps of Engineers, until March 30, 1889, and after that Capt. Thomas Turtle, Corps of Engineers. Lieut. G. J. Fieberer, Corps of Engineers, was under the immediate orders of the officer in charge from August 30 to November 22, 1888, and Lieut. W. E. Craighill, Corps of Engineers, temporarily under his immediate orders from January 12 to March 29, 1889.

1. *Great Kanawha River, West Virginia.*—This river flows through a fertile and picturesque region, filled with mineral wealth, especially coal and salt. It was by nature divided into a number of pools, some of considerable length and depth, separated by shoals of gravel and coarse sand, which were the principal obstructions to navigation in low water, there being often on them at such seasons but a few inches of water. In some of the pools were found shallow places, also obstructing navigation. There were also snags and loose rocks in the channel. The navigation above Charleston was more obstructed than below. Above, it was almost suspended in summer.

The coal and salt were generally sent out on rises, which enabled the boats to pass safely over the obstructions that otherwise would stop their movements entirely. The use of the river for the movement of these valuable products was therefore unsatisfactory and intermittent. By the agency and superintendence of a board acting under the State, first of Virginia and then of West Virginia, considerable improvement

in the river was from time to time effected, tolls being charged on the commerce for the payment of expenses.

The object of the improvement begun several years ago by the United States was to give a constant navigable depth of at least 6 feet throughout the whole length of the Kanawha to its mouth at the Ohio River, to be accomplished by large locks and dams. Those already built have been about 300 by 50 feet.

The peculiarity of most of the dams is that they can be lowered when the stage of the water in the river will suffice over the shoals. This gives them the name of "movable dams," and enables an open river to be had where the water is high enough.

Dams 3 and 2, both above Paint Creek, are fixed, as the declivity of the river in that section is too great to permit the advantageous use of the movable system.

Up to June 30, 1888, the amount expended was \$1,941,250.05.

At that date Locks and Dams 2, 3, 4, 5, and 6 had been completed.

The amount expended in the year ending June 30, 1889, exclusive of outstanding liabilities, was \$34,953.28.

Lock No. 7 was let at contract on November 26, 1888, and preliminary work was commenced in January, and the excavating for and the placing of the coffer-dam, and the quarrying and cutting of stone is now in progress.

Had funds been available all the locks and dams needed for this improvement could have been begun at the same time and finished in three years, with much economy to the United States and with manifest advantage in the use of the improved water-way.

The development of commerce on this river has been very great since its improvement by the United States, although the project has been only partially executed for want of money.

It is regretted that delay in the preparation of the deeds for the site of Lock and Dam No. 8 has prevented the letting of work upon the lock up to this time, whereby this season has been practically lost to that work.

Summarily the work for the past season has been as follows:

Operating at two fixed dams and three movable ones, extending riprapping, building cribs at head of lock and completing lock-house at No. 2; work preparatory to changing filling-valves at No. 3; commencement of work at No. 7, including the construction of a lock-house; acquisition of site for No. 8, and advertisement for the lock; dredging by the Government dredge at Lock No. 2, from the approaches at Locks 3 and 5—at Harvey's Shoal, at Witcher's Shoal; repairs to plant; building new dump-boat; repairs to and extension of telephone line, and preparation of plans for No. 8 and for the lock-house thereat.

During the long-continued season of low water in 1887 the value of the improvement was shown in a very marked manner, as free and sufficient navigation was maintained through it over the improved part of the river, while navigation was entirely suspended below the lowest dam and above the upper pool.

July 1, 1888, amount available	\$5,895.62
Amount appropriated by act of August 11, 1868	350,000.00
	<hr/> 355,895.62
July 1, 1889, amount expended during fiscal year, exclusive of	
liabilities outstanding July 1, 1888	\$34,953.28
July 1, 1889, outstanding liabilities	3,000.00
July 1, 1889, amount covered by existing contracts	130,534.05
	<hr/> 168,487.33
July 1, 1889, balance available	187,408.29

{ Amount (estimated) required for completion of existing project\$370,000. 00
 { Amount that can be profitably expended in fiscal year ending June 30, 1891 500,000. 00
 { Submitted in compliance with requirements of sections 2 of river and
 harbor acts of 1866 and 1867.

(See Appendix F F 1.)

2. *Operating and care of the locks and dams on the Great Kanawha River, West Virginia.*—Amount expended during the fiscal year ending June 30, 1889, \$19,399.35.—(See Appendix F F 2.)

3. *Elk River, West Virginia.*—The country through which this stream flows is rich in minerals and well fitted for agriculture and grazing. The project of improvement under which operations have been carried up to the present time, has been the removal of rocks, snags, overhanging trees, etc., the cutting of sluices through the rapids and shoals and the construction of wing-dams where needful. The principal interests to be served are those of lumbering and rafting; but much country produce is also carried down-stream in small boats, and merchandise, etc., returned. The act of March 3, 1875, directed an examination to be made of this river between its mouth and Braxton Court House, otherwise known as Suttonville or Sutton, and to this examination \$500 was allotted. (Report Chief of Engineers 1876 Part II, page 166).

The average fall per mile between Braxton Court House and Charleston is about 2½ feet; but this is unequally distributed as the central section has a fall of nearly 4 feet per mile, while the upper and lower sections have an average of less than 2 feet. The low-water volume of the river, amounting to about 80 cubic feet per second, is entirely inadequate to supply the demands of any scheme of "open river" navigation at low water.

The first appropriation was in June, 1878. The total expenditure to June 30, 1886, was \$17,000. The work done up to that time was of great benefit to the comparatively undeveloped section through which the river flows. The law of August, 1886, contained an item of \$1,500, but the sum was so small that it was held until re-enforced by \$3,000 appropriated August 11, 1888. Work was then resumed and nearly \$4,000 of the \$4,500 available was expended during the autumn.

The amount expended to the close of the fiscal year ending June 30, 1888, is \$17,000, and the amount expended in the year ending June 30, 1889, is \$3,925.11.

July 1, 1888, amount available	\$1,500. 00
Amount appropriated by act of August 11, 1888	3,000. 00
	<hr/>
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	4,500. 00
	3,925. 11
	<hr/>
July 1, 1889, balance available	574. 89

{ Amount that can be profitably expended in fiscal year ending June 30, 1891 2,500. 00
 { Submitted in compliance with requirements of sections 2 of river and
 harbor acts of 1866 and 1867.

(See Appendix F F 3.)

4. *Gauley River, West Virginia.*—Operations for the improvement of the Gauley River were instituted by examination made in 1887, in accordance with the provisions of the river and harbor act of August 5, 1886. As a result of those examinations it was pointed out that a valuable improvement of the 12 miles of river from the mouth to the "Roughs" could be made at an expense of \$10,000, and that a great advantage would follow the expenditure of \$65,000 in the 26-mile reach,

called the "Roughs," in facilitating and cheapening the bringing to market of millions of feet of lumber of the most valuable and varied kinds.

The river and harbor act of August 11, 1888, appropriated \$3,000 for cleaning out the channel. The project approved for the expenditure of this small sum contemplated the removal of ledges of solid rock, and the making of channels through eighteen shoals of loose rock and boulders, commencing at Scramble Creek, about three-fourths of a mile above the mouth, and extending to the pool above Rich Creek, a distance of 10 miles. The work was carried on by the hire of labor and the purchase of materials in open market, the circumstances not permitting contract work from considerations of economy and advantage.

Of the \$3,000 appropriated, \$1,266.42 has been expended towards improving the channels in accordance with the project above mentioned, and the balance will be applied in the same work as soon as circumstances permit.

Amount appropriated by act of August 11, 1888.....	\$3,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	1,266.42
July 1, 1889, balance available	1,733.58
{ Amount (estimated) required for completion of existing project	7,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	7,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix F F 4.)	

5. *New River, from the mouth of Wilson, in Grayson County, Virginia, to the mouth of Greenbrier River, West Virginia.*—The appropriations have been made in such manner as to divide this portion of the river into three sections, as follows :

	Miles.
Upper, or Lead Mines.....	62
Middle, or New River Bridge.....	43
Lower, or Greenbrier.....	86½

Throughout this distance the navigable channel consisted of natural chutes through the ledges and shoals of varying widths, rarely over 1 foot in depth, in some places so tortuous as to render navigation extremely difficult and dangerous.

The original project adopted for the improvement of these natural channels was to widen them to 30 or 50 feet, as might be required, deepen them to 2 feet, and straighten such as needed it. This was for bateau navigation; the improvement, however, to be made in such a manner as to aid the work should a greater depth and width be required in the future.

A small steam-boat, draught 12 inches when light, having been built at Hinton in the fall of 1878, rendered it necessary to make the channel in that section 50 feet wide at all points, and in many from 75 feet to 100 feet, the depth of 2 feet being retained. This steam-boat was not adapted, in dimensions and power, to the navigation of the river, and was withdrawn.

The original plan of improvement has been adhered to, except that the width of channel on the middle and upper divisions has been reduced to 20 feet, and on the former to 10 feet for several miles, to allow iron to be shipped from the furnaces above.

There was no appropriation for this river in 1883, 1884, and 1885. July 1, 1886, there was a balance remaining unexpended of \$3,000 from

the appropriation of August 2, 1882. This pertained by special designation of the law to the portion of the river above Foster's Falls, which are not passable. The balance remained unexpended because of the impassability of these falls. As the disconnection with routes of transportation caused by these falls would practically disappear on the completion of the railroad up Cripple Creek, and as boats could then ship to the railroad their freight at Porter's Ferry above the lead mines and the falls, it was concluded to improve the condition of Williamson's ledges and shoals. This work was continued as late as the season allowed, a small balance of funds being left unexpended, but not large enough to justify the resumption of operations in the summer of 1886.

There was an appropriation of \$10,000 in the law of August 5, 1886, applicable only to the portion of the river above the lead mines. When the money became available it was too late to commence operations in 1886. For more than one reason it seemed inexpedient to expend this appropriation in the year ending June 30, 1888. The portion of the river to which it is applicable is above Foster's Falls, and these can only be passed by one or two locks at a cost much greater than Congress is likely to authorize. There is also strong reason for doubt whether, considering the present development of that section of the country, the construction of such locks would be justifiable even if the money were available. The construction of railroads near this stream has, for the present, diminished very much the importance of the improvement of the portion above Foster's Falls. After a careful re-examination of the subject and a reconnaissance of the river and its vicinity, it was decided to postpone the expenditure of the appropriation until the will of Congress could be further ascertained.

In the river and harbor act of August 11, 1888, it was directed that the balance should be spent in improving the river between Ivanhoe Furnace, in Wythe County, and the mouth of Wilson Creek. Operations in accordance with this direction have commenced.

July 1, 1888, amount available.....	\$10, 147. 29
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	1, 411. 05
July 1, 1889, balance available.....	8, 736. 24
<hr/>	
{ Amount (estimated) required for completion of existing project	159, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix F F 5.)	

**IMPROVEMENT OF TRADEWATER, KENTUCKY, AND LICKING RIVERS—
OPERATING AND KEEPING IN REPAIR LOCKS AND DAMS ON THE
GREEN AND BARREN AND KENTUCKY RIVERS, KENTUCKY—IM-
PROVEMENT OF BIG SANDY RIVER, WEST VIRGINIA AND KEN-
TUCKY, AND OF GUYANDOTTE, LITTLE KANAWHA, AND BUCK-
HANNOH RIVERS, WEST VIRGINIA.**

Officer in charge, Maj. D. W. Lockwood, Corps of Engineers, with
Lient. W. L. Sibert, Corps of Engineers, under his immediate orders.
Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. *Tradewater River, Kentucky.*—This work was in charge of Maj.
Amos Stickney, Corps of Engineers, until September 5, 1888, when it
was transferred to Maj. D. W. Lockwood, Corps of Engineers.

This river was practically closed by a rock-bar near its mouth, and
higher up by logs, snags, drift-piles, leaning trees, and bars.

The present project, adopted in 1881, provides for clearing the river and its banks of obstructions, and opening up a channel 40 feet wide and 2½ feet deep during six months of the year, the improvement to extend 41 miles up-stream.

Up to June 30, 1888, \$10,128.46 were expended, resulting in clearing a channel through the rock-bar near the mouth of the river, removing the obstructions in the river for a distance of 24½ miles, clearing the banks for a distance of 14 miles and deadening the timber on the banks for the remaining 27 miles.

During the fiscal year ending June 30, 1889, \$67.10 was expended in caring for property.

No work was done during the year on account of high water.

The amount available will complete the work.

July 1, 1888, amount available.....	\$371.54	
Amount appropriated by act of August 11, 1888	6,000.00	
		6,371.54
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$65.00	
July 1, 1889, outstanding liabilities.....	2.10	
		67.10
July 1, 1889, balance available		6,304.44

(See Appendix G G 1.)

2. *Operating and keeping in repair the locks and dams on the Green and Barren rivers, Kentucky.*—When the United States assumed charge of these improvements, December 11, 1888, the condition of the work was as follows: 1st. The river wall of Lock No. 3 was down. 2d. The land-wall of No. 1, Barren, and both walls of No. 3, Green, were in a dangerous state and liable to yield at any time. 3d. The channel was almost closed by snags, trees, and other obstructions. 4th. The buildings, grounds, approaches to locks, and in fact everything connected with the improvements, were in a generally dilapidated condition. 5th. The dams were much in need of extensive repairs.

During the fiscal year ending June 30, 1889, \$46,557.77 was expended, resulting in the removal of the fallen wall at No. 3, Green River, excavating in rear of the land-wall at No. 1, Barren River; the construction of a crib to sustain river-wall at No. 2, Green River; the building of two derrick-boat hulls, two stone barges, one hull for dredge, and general repairs to dwellings, dams, etc.

The amount estimated for operating and care of locks and dams for fiscal year ending June 30, 1890, is \$256,221.35.

It is proposed to complete repairs to Locks Nos. 2 and 3, Green River, and No. 1, Barren River; to rebuild and repair dams where necessary; to build lock-keepers' dwellings; to construct a snag-boat, and put in guide-cribs at entrance to locks and grade and pave ground about locks. The snag-boat will be put to work as soon as completed.

(See Appendix G G 2.)

3. *Kentucky River, Kentucky.*—The condition of the river when the United States assumed charge of its improvements, April 30, 1880, was as follows:

The five locks and dams with their approaches, built by the State, were in a dilapidated condition. The channel was much obstructed by snags and leaning trees.

Up to June 30, 1888, \$891,379.19 were expended, resulting in restor-

ing the locks to a navigable condition, clearing the channel and banks of obstructions, and the commencement of two new locks.

During the fiscal year ending June 30, 1889, \$229,207.57 was expended, and resulted in quarrying for the new lock at Beattyville 10,419 cubic yards of dimension stone, and in cutting 929 cubic yards of dressed face, 374 cubic yards special, 1,097 cubic yards pitch or quarry face, 837 cubic yards squared and 3,646 cubic yards backing stone; 65,475 cubic yards of earth and rock was excavated in stripping and extending quarry.

At Lock No. 6 all the stone required for its construction was contracted for and its cost is included in the amount reported as expended during the year.

To complete the two locks and dams with their abutments, now in process of construction, and to commence work on Locks Nos. 7 and 8, an appropriation of \$400,000, for the fiscal year ending June 30, 1891, is recommended.

July 1, 1888, amount available.....	\$96,120.81
Amount appropriated by act of August 11, 1888.....	180,000.00
Received from Tabler and Cogar.....	500.00

276,620.81

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$133,018.79
July 1, 1889, outstanding liabilities.....	27,749.53
July 1, 1889, amount covered by existing contracts.....	68,439.25

229,207.57

July 1, 1889, balance available.....	47,413.24
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{ Amount (estimated) required for completion of existing project.....	1,854,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	400,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix G G 3.)

4. *Operating and keeping in repair the locks and dams on the Kentucky River, Kentucky.*—The first allotment for this work was for the fiscal year ending June 30, 1885, at which time only four locks could be operated; these required extensive repairs at that time, and the dams and approaches were in generally poor condition.

The amount of money expended to June 30, 1888, was \$159,151.64, and resulted in placing the locks and dams in serviceable condition, in rebuilding guide-cribs for upper and lower approaches to locks, in building one double and one single lock-keepers' dwellings, and in keeping the channel clear of obstructions.

The amount expended during fiscal year ending June 30, 1889, was \$81,703.36, and resulted in rebuilding and extending guide-walls and cribs at lock entrances; general repairs to locks and dams, building four new lock-keepers' dwellings, in grading, paving, and sodding grounds about locks, and fencing Government property. The stone for a new abutment at No. 2 was gotten out. The amount estimated for operating and care of locks and dams for fiscal year ending June 30, 1890, is \$72,394.80. It is proposed to complete the crib approaches to the locks, build the new abutment at No. 2, build one double and two single lock-keepers' dwellings, and keep the channel free from snags, etc.

(See Appendix G G 4.)

5. *Licking River, Kentucky, from Farmer's to West Liberty.*—This stream was originally much obstructed by logs, snags, rocks, and leaning trees, as well as by fish-dams constructed by private parties.

The project for the improvement of this stream was adopted in 1888, and provides for removing the snags, detached rocks, and bowlders from the river bed.

No money was expended or work done during the fiscal year ending June 30, 1888.

During the fiscal year ending June 30, 1889, \$792.51 was expended in providing a suitable outfit for work, and the most pronounced obstructions were removed for a distance of 22 miles from Farmer's, after which the party proceeded to West Liberty to work down stream.

Amount appropriated by act of August 11, 1888.....	\$3,000.00
July 1, 1889, amount expended during fiscal year, exclusive of	
liabilities outstanding July 1, 1888.....	\$392.26
July 1, 1889, outstanding liabilities.....	400.25
	<hr/> 792.51

July 1, 1889, balance available	2,207.49
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{ Amount (estimated) required for completion of existing project.....	14,680.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	5,000.00
{ Submitted in compliance with requirements of sections 2 of river and	
harbor acts of 1866 and 1867.	

(See Appendix G G 5.)

6. *Big Sandy River, Kentucky and West Virginia.*—When the United States commenced improving this stream, it and its forks were much obstructed by rocks, bars, logs, snags, and leaning trees. During the low-water season navigation was practically suspended.

Up to the close of the fiscal year ending June 30, 1888, \$230,537.62 had been expended, resulting in the clearing out of the Big Sandy and its forks, and in the construction of the masonry of a lock at Louisa, a short distance below the forks, as well as the abutment for the dam.

During the fiscal year ending June 30, 1889, \$11,761.36 were expended, resulting in removing 2,000 cubic yards of rock from the lower approach to the lock, and placing most of it behind the abutment. The gates and wickets were nearly completed, and the river from the lock to the Ohio cleared of obstructions; \$31,145.31 will complete the lock and dam.

July 1, 1888, amount available	\$3,462.38
Amount appropriated by act of August 11, 1883.....	31,500.00
	<hr/> 34,962.38

July 1, 1889, amount expended during fiscal year, exclusive of	
liabilities outstanding July 1, 1888	\$10,990.26
July 1, 1889, outstanding liabilities.....	762.10
	<hr/> 11,761.36

July 1, 1889, balance available.....	23,201.02
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{ Amount (estimated) required for completion of existing project.....	31,145.31
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	31,000.00
{ Submitted in compliance with requirements of sections 2 of river and	
harbor acts of 1866 and 1867.	

(See Appendix G G 6.)

7. *Guyandotte River, West Virginia.*—This stream was originally much obstructed by snags, logs, and leaning trees; besides, there existed a number of dams owned by private parties which required removal.

The project for the improvement of the stream was adopted in 1878, and provided for the removal of existing obstructions, natural and artificial, so as to form a channel 30 feet wide, with a least depth of 18 inches during five months of the year, and extending up the river 122 miles.

Up to the close of the fiscal year ending June 30, 1888, \$12,500 had been expended, resulting in the improvement of the river for a length of 119 miles, and the partial removal of Roger's mill-dam 13 miles from the mouth. Peck's mill-dam should also be removed. No work was done during the fiscal year ending June 30, 1889, on account of high water. The \$2,000 asked for in addition to the balance now on hand will complete the improvement.

Amount appropriated by act of August 11, 1888.....	\$2,000. 00
July 1, 1889, balance available.....	2,000. 00

{ Amount (estimated) required for completion of existing project.....	2,000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	2,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix G G 7.)

8. *Little Kanawha River, West Virginia.*—This river, at the time improvements were commenced by the United States, was much obstructed by logs, snags, leaning trees, etc., above that portion controlled by the Little Kanawha Navigation Company.

Up to the close of the fiscal year ending June 30, 1888, \$145,540.73 had been expended, which resulted in clearing the stream of existing obstructions, and in the partial construction of a lock which, with its dam, will extend slack-water navigation 12 miles. All the stone required was on hand and part of it ready to lay in the lock-walls.

During the fiscal year ending June 30, 1889, \$15,658.36 were expended. The river-wall was completed and the foundation of land-wall partly put in.

It is estimated that \$40,000 will complete the lock and dam.

July 1, 1888, amount available	\$334. 27
Amount appropriated by act of August 11, 1888.....	25,000. 00

25,334. 27

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$11,681. 79
July 1, 1889, outstanding liabilities.....	3,976. 57
	15,658. 36

July 1, 1889, balance available.....	9,675. 91
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{ Amount (estimated) required for completion of existing project.....	40,000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	27,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix G G 8.)

9. *Buckhannon River, West Virginia.*—This stream was originally so obstructed by rocks and log jams that timber could be floated out only on a 12-foot rise.

The project for its improvement adopted in 1884 provides for the formation of a rafting channel $24\frac{1}{2}$ miles long, with a minimum width of 30 feet.

Up to the close of the fiscal year ending June 30, 1888, \$3,000 had been expended, resulting in clearing the channel for about 13 miles above the town of Buckhannon, so that logs could be rafted out on a 5-foot rise.

During the fiscal year ending June 30, 1889, \$959.92 was expended, which resulted in extending the cleared channel $1\frac{1}{2}$ miles.

Amount appropriated by act of August 11, 1888	\$1,500.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	959.92
July 1, 1889, balance available	540.08
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{ Amount (estimated) required for completion of existing project	20,955.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	3,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix G G 9.)	

EXAMINATIONS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examination of *Big Sandy River, Kentucky, from Catlettsburgh to Pikeville, on Louisa Fork, and to the mouth of Pond Creek on Tug Fork*, was made by the local engineer, Major Lockwood, and reported by him as worthy of improvement. This conclusion being concurred in by the Chief of Engineers, and the report of the preliminary examination containing information sufficient to indicate to Congress the probable cost of the work required, no further report or survey appeared to be necessary. The improvement proposed is to canalize the river and its forks by means of locks and dams, at an estimated cost of \$3,396,600. (See Appendix G G 10.)

LAKE HARBORS AND RIVERS.

IMPROVEMENT OF HARBORS ON LAKE SUPERIOR.

Officer in charge, Maj. James B. Quinn, Corps of Engineers. Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. *Harbor at Grand Marais, Minnesota.*—This was originally a natural harbor basin, but of insufficient depth for large vessels, and not wholly protected from storms. The need of a harbor of refuge in this locality was apparent, owing to the long stretch of coast-line between existing available harbors, and led to the project for the improvement of Grand Marais Harbor for that purpose.

The present project for its improvement, adopted in 1879, consisted of deepening the basin to 16 feet and constructing a breakwater out from Mayhew's Point so as to partially close the natural opening and lessen the exposure to storms. The project was amended in 1888 so as to provide for the dredging of the entire harbor area within the 5-foot curve and to lengthen the breakwater by 350 feet.

The amount expended to the close of the fiscal year ending June 30, 1889, was \$81,461.75, and has resulted in obtaining a dredged area of about 12 acres, with a ruling depth of 16 feet, and the construction of 350 linear feet of breakwater. The harbor is now accessible for vessels of the largest size and draught that come to Lake Superior, but the smallness of the dredged basin limits its accommodation to but very few vessels at one time.

The breakwater is of much service for the protection of shipping.

The amount expended during the past year was \$3,833.93, and has resulted in the removal of 14,572.4 cubic yards of material from the harbor basin.

July 1, 1888, amount available	\$2,422.23
Amount appropriated by act of August 11, 1888	15,000.00

17,422.23

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$276.20
July 1, 1889, outstanding liabilities	3,607.78
July 1, 1889, amount covered by existing contracts	11,502.62

15,386.60

July 1, 1889, balance available	2,035.63
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{ Amount (estimated) required for completion of existing project	44,700.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	44,700.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H H 1.)

2. *Harbor at Agate Bay, Minnesota.*—This harbor, on the north shore of Lake Superior, 27 miles from Duluth, is a shipping port for iron ore. It also serves the purpose of a harbor of refuge. Its naturally deep water renders but little dredging necessary in order for vessels to reach the docks.

The present project for improvement of this harbor, adopted in 1887, consists in the construction of two breakwater piers, extending from the eastern and western points of the bay, to be 1,000 and 900 feet long, respectively, and on a line towards each other, leaving an opening of 1,340 feet between the outer extremities and inclosing an area of 109 acres.

The amount expended thereon to June 30, 1889, was \$29,006.59, and had resulted in the construction of 400 linear feet of the east breakwater and the partial completion of 150 feet additional, which is under contract to be completed by October 1, 1889.

The 400 feet already completed has given very material protection to vessels, lying at Merchandise Dock, from southerly storms. The appropriation asked is to be applied to the completion of the east 1,000 feet of breakwater.

July 1, 1888, amount available	\$1,817.06
Amount appropriated by act of August 11, 1888	15,000.00

16,817.06

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$968.15
July 1, 1889, outstanding liabilities	7,355.50
July 1, 1889, amount covered by existing contracts	5,213.50

13,537.15

July 1, 1889, balance available	3,279.91
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{ Amount (estimated) required for completion of existing project	206,708.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	50,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H H 2.)

3. *Harbor at Duluth, Minnesota.*—The original project for the improvement of the harbor, adopted in 1871, consisted of a breakwater in Lake Superior, outside of Minnesota Point, in continuation of a breakwater already commenced by the Northern Pacific Railroad Company. This breakwater was destroyed by a storm in 1872 and abandoned. In 1873 Congress provided for maintaining the canal through Minnesota Point, which had been constructed by the city of Duluth, and for dredging channels in Superior Bay to the Duluth docks.

Work under this project was continued until 1881, at which time the piers of the canal had been repaired and somewhat extended, a harbor basin dredged of moderate capacity, and a narrow channel dredged in Superior Bay from Duluth to deep water at Connor's Point. The amount expended under this project was \$270,651.81.

The present project was adopted in 1881 and modified in 1884 and 1888, the object being to preserve the piers bordering the canal, dredging an inner harbor to accommodate vessels drawing 16 feet of water, channel parallel with the Park Point dock line 100 feet wide, channel east of Rice's Point 200 feet wide, 17 feet deep, and channel on north shore of St. Louis Bay 200 feet wide, 17 feet deep.

The amount expended under present project to June 30, 1889, was \$229,816.80, and has resulted in increasing the dredged area of basin to about 104 acres, exclusive of private dredging, removing shoals from area previously dredged, giving the whole dredged basin a minimum depth of 16 feet, deepening the Blast Furnace Channel to a like depth, maintaining the canal piers and commencement of channels east of Rice's Point and on north shore of St. Louis Bay.

Work during the past fiscal year consisted in dredging channel east of Rice's Point 45 feet wide and 17 feet deep for a distance of 2,640 feet, and dredging channel on north shore of St. Louis Bay about 50 feet wide and 16 feet deep for a distance of 7,300 feet. The amount of material excavated from former channel was 53,685.5 cubic yards, and from the latter 114,174.3 cubic yards.

The canal piers are in fairly good condition, but the superstructure, and perhaps the entire work, will eventually require to be replaced with more durable material. The ruling depths in the portions of the harbor dredged by the United States are:

	Feet.
In canal.....	17
In the inner basin or harbor.....	16
In Blast Furnace Channel to a point opposite "Elevator E".....	16
From point opposite "Elevator E," through dredged channel along east side of Rice's Point, to the St. Louis River.....	12
In channel on north shore of St. Louis Bay for a distance of 7,300 feet.....	16
In new channel east of Rice's Point for a distance of 2,640 feet.....	17

All the areas and channels above mentioned (canal and channel from point opposite Elevator E, etc., to the St. Louis River excepted) require widening.

Since 1881 the narrow channel which was dredged from Duluth to deep water at Connor's Point has shoaled so that it now has a ruling depth of 12 feet, and large vessels can only pass through light.

July 1, 1888, amount available.....	\$3,799. 14
Amount appropriated by act of August 11, 1888	80,000. 00
	<hr/> 83,799. 14

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$15,446. 47
July 1, 1889, outstanding liabilities.....	16,522. 09
July 1, 1889, amount covered by existing contracts.....	34,500. 17
	<hr/> 66,468. 72

July 1, 1889, balance available	17,330. 42
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(Amount (estimated) required for completion of existing project	324,526. 00
Amount that can be profitably expended in fiscal year ending June 30, 1891	150,000. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H H 3.)

4. *Harbor at Superior Bay and St. Louis Bay, Wisconsin.*—Originally a sand-bar obstructed the natural entrance to Superior Bay, with a narrow and tortuous channel through it having a minimum depth of 9 feet. In Superior Bay a deep natural channel, having a depth of not less than 14 feet and a width of from 100 to 500 feet, extended from the natural entry to Connor's Point. Nine feet was the greatest draught that could reach the docks at Superior one-half mile distant from the natural channel.

The original project, adopted in 1867 and modified in 1873, comprised the construction of parallel piers 350 feet apart and dredging between the piers; dredging in Superior Bay from natural channel to Quebec Wharf; maintenance of piers and projecting proportions of Minnesota Point where the sea threatened to break through. The amount expended on the original project was \$335,513.26.

The present project was adopted in 1881 and modified in 1884, which added improvement of St. Louis River channel within the bay of Superior, the object being to provide channels for vessels drawing 16 feet of water. The act of August 5, 1886, added the improvement of St. Louis Bay.

The natural and dredged channels in 1881 were about 100 feet wide, with not more than 11 feet in depth at the shoalest part.

The amount expended under present project to June 30, 1889 was \$128,371.06, exclusive of amount covered by existing contracts, and has resulted in securing channels having a minimum width of 100 feet and not less than 16 feet in depth.

Work during the past year, to June 30, 1889, has been confined to dredging in the channel, between Connor's Point and the entry, straightening and widening the channel at the "middle ground," about one-half mile north of Safford's Pier. The quantity of material removed to the end of the fiscal year was 75,700 cubic yards.

The entry piers are in fair condition, but need extensive repairs, particularly the superstructure, to render them secure. The beach protection is still intact.

The following are the ruling depths in the channels dredged by the United States:

	Feet.
From Connor's Point to the entry.....	16
From Northern Pacific Railroad Dock to the entry	16
In front of Quebec Dock.....	16
Throughout the entry between piers.....	16
July 1, 1888, amount available	\$10,270.33
Amount appropriated by act of August 11, 1888.....	50,000.00
	<hr/> 60,270.33
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$3,762.97
July 1, 1889, outstanding liabilities.....	6,512.18
July 1, 1889, amount covered by existing contracts.....	28,402.00
	<hr/> 41,677.15
July 1, 1889, balance available	<hr/> 18,593.18

{ Amount (estimated) required for completion of existing project.....	291,736.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	100,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H H 4.)

5. *Harbor at Ashland, Wisconsin.*—In charge of Maj. C. E. L. B. Davis, Corps of Engineers, until September 4, 1888. The original project for

the improvement of this harbor was adopted in 1887, and had for its object the closing of the breach in Chequamagon Point by a pile revetment about 4,300 feet long, and to dredge a channel 100 feet wide and 18 feet deep in front of and touching the principal wharves of the city. This project was abandoned, and a new one was approved for the construction of about 8,000 feet of breakwater northeast of the town, and for dredging a channel in front of the wharves of the city to accommodate vessels drawing 16 feet of water. This project was modified in 1889 so as to provide for the construction of 4,650 feet of breakwater extending into the bay about 1,000 feet east of the iron-ore docks, and to be built of piles and slabs with rock ballast.

There is sufficient depth of water in the vicinity of the ore docks, but it is too shoal in front of the western part of the city to accommodate shipping.

The amount expended under approved project to June 30, 1889, was \$9,034.81. At that date 100 feet of breakwater had been completed and piling for 1,100 feet driven. By October 31, 1889, the whole of the 4,650 feet will have been completed, and it is believed that the beneficial effects to commerce resulting from its construction will be considerable.

July 1, 1888, amount available	\$20,993.03
Amount appropriated by act of August 11, 1888	60,000.00
	<hr/> 80,993.03
July 1, 1889, amount expended during fiscal year, exclusive of	
liabilities outstanding July 1, 1888	\$1,050.84
July 1, 1889, outstanding liabilities	6,477.00
July 1, 1889, amount covered by existing contracts	47,288.50
	<hr/> 54,816.34
July 1, 1889, balance available	26,176.69
	<hr/>
{ Amount (estimated) required for completion of existing project	90,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	60,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix H H 5.)	

6. *Harbor at Ontonagon, Michigan.*—In charge of Maj. C. E. L. B. Davis, Corps of Engineers, until September 4, 1888. The present project for the improvement of this harbor was adopted in 1867, the object being to afford an entrance to the mouth of the Ontonagon River, not less than 12 feet deep, and of a navigable width. This result was to be accomplished by constructing two parallel piers, 250 feet apart, from the mouth of the river lakeward to the 18-foot contour in Lake Superior, and dredging a channel between them 12 feet deep.

The natural channel was but 7 feet in depth, and owing to the shifting nature of the bottom was variable in position.

The amount expended to the close of the fiscal year ending June 30, 1889, was \$284,903.74, and has resulted in the construction of 2,315 feet of east and 2,525 feet of west pier, and the removal of 10,546 cubic yards of material, making a channel 100 feet wide and 13 feet deep between the piers with a depth of 12.1 feet on the outer bar.

By September 30, 1889, the west pier will have been extended 150 feet, and superstructure will have been completed on the crib sunk in 1887 on the east pier.

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July 1, 1888, amount available.....	\$1,541.96
Amount appropriated by act of August 11, 1888.....	12,500.00

14,041.96

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$680.72
July 1, 1889, outstanding liabilities.....	165.00
July 1, 1889, amount covered by existing contracts.....	10,640.00
	<hr/> 11,485.72

July 1, 1889, balance available.....	2,556.26
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{ Amount (estimated) required for completion of existing project.....	65,670.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	25,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H H 6.)

7. *Eagle Harbor, Michigan.*—In charge of Maj. C. E. L. B. Davis, Corps of Engineers, until September 4, 1888. Previous to the improvement of Eagle Harbor, the entrance was obstructed by a rocky reef, with 8½ feet of water over the shoalest part.

The project for the improvement of this harbor was adopted in 1866, and modified in 1868, 1874, and 1878. The plan as finally carried out consisted in blasting and dredging through the rocky ledge a channel 130 feet wide and 14 feet deep, and marking it by two guiding-cribs, one on each side of the channel, and the removal of a number of bowlders.

The amount expended to the close of the fiscal year ending June 30, 1889, was \$94,513.67, and has resulted in carrying out the above project, the work having been completed in 1885 and meeting the present demands of commerce.

No appropriation is asked for this harbor, as the funds on hand will probably be sufficient to keep the channel and cribs in good condition for several years.

July 1, 1888, amount available.....	\$2,486.33
July 1, 1889, balance available.....	2,486.33

(See Appendix H H 7.)

8. *Harbor at Marquette, Michigan.*—In charge of Maj. C. E. L. B. Davis, Corps of Engineers, until September 4, 1888. In its original condition this harbor afforded no protection to vessels during the prevalence of easterly and northeasterly storms.

The present project for the improvement of this harbor was adopted in 1866, and consisted in the construction of crib breakwater 2,000 feet long and 25 to 40 feet wide, built to a height of 6 feet above the water surface, the estimated cost being \$385,129.58. Previous to the commencement of work these widths were changed to 20, 25, and 30 feet. The structure was completed in 1875, the total length being 2,010 feet. The total amount expended to June 30, 1889, was \$321,641.40.

Work will be commenced on July 1, 1889, on the extension of 180 feet to the breakwater, which will be completed by November 15, 1889.

The importance of Marquette Harbor both as a shipping port and a harbor of refuge, and the present limited anchorage area, makes it urgently necessary to extend the breakwater at least 1,000 feet, in addition to the 180 feet under contract to be completed by the end of the present working season.

The estimated cost of this proposed 1,000 feet extension is placed at \$121,000, and when completed would afford ample protection to the

commerce of this harbor for some years, as it would increase the safe anchorage area about 100 per cent.

July 1, 1888, amount available.....	\$9,000.86
Amount appropriated by act of August 11, 1888.....	25,000.00
	<u>34,000.86</u>

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$1,346.77
July 1, 1889, outstanding liabilities.....	65.49
July 1, 1889, amount covered by existing contracts.....	19,800.00
	<u>21,212.26</u>

July 1, 1889, balance available.....	<u>12,788.60</u>
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{ Amount (estimated) required for completion of proposed project	121,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	50,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.....	

(See Appendix H H 8.)

9. *Harbor of Refuge at Grand Marais, Michigan.*—In charge of Maj. C. E. L. B. Davis, Corps of Engineers, until September 4, 1888. The original condition of the channal was variable and crooked, with about 6 feet depth of water.

The present project for the improvement of this harbor was adopted in 1881, the object being to provide a harbor of refuge for vessels navigating Lake Superior, and consists in the formation of an artificial entrance to the natural harbor, having an available capacity of 160 acres and capable of being increased to 240 acres should the needs of commerce require it.

This artificial entrance is to be formed of two parallel crib-piers 500 feet apart, with a dredged channel between, 300 feet wide and from 18 to 20 feet in depth, cut through the sand-spit north of the harbor, connecting the deep water of the lake with that of the harbor.

The amount expended to June 30, 1889, was \$144,059.47, and has resulted in the construction of 1,450 feet of the west pier, including 100 feet of pile-dike, and 850 feet of the east pier, including 100 feet of pile-dike; 1,200 feet of the piers are unprovided with superstructures.

The amount expended during year ending June 30, 1889, was \$31,908.79, including liabilities outstanding July 1, 1888, and has resulted in the extension of the west pier by four cribs, each 24 feet wide, and the building of 400 feet of superstructure on the cribs of the west pier, 20 feet wide, 6 feet high.

By September 30, 1889, the remainder of the piers unprovided with superstructures (1,200 feet) will have been completed, 650 feet on the west pier and 550 feet on the east pier, and a channel 150 feet wide and 17 feet deep will have been dredged between the piers from the 17-foot contour of the lake to the deep water of the harbor. The quantity of material excavated to the end of the fiscal year was 27,171.4 cubic yards.

July 1, 1888, amount available.....	\$1,839.55
Amount appropriated by act of August 11, 1888.....	50,000.00
	<u>51,839.55</u>

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	1,825.10
July 1, 1889, outstanding liabilities.....	12,823.92
July 1, 1889, amount covered by existing contracts.....	32,361.56
	<u>47,010.58</u>

July 1, 1889, balance available.....	<u>4,828.97</u>
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{ Amount (estimated) required for completion of existing project.....	\$268, 750. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	100, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H H 9.)

10. *Establishment and maintenance of harbor lines in Portage Lake, Michigan.*—In charge of Maj. C. E. L. B. Davis, Corps of Engineers, until September 14, 1888. Congress, by act of August 5, 1886, conferred upon the Secretary of War the authority to establish harbor lines where débris of mines or stamp-works were liable to work injury to navigation. Harbor lines were accordingly established in Portage Lake, Michigan, to prevent the destruction of through routes of communication across Keweenaw Point, and rules and regulations were prescribed for maintaining them.

Notwithstanding these regulations the stamp-mills on Portage Lake continue to dump their tailings outside of these lines, and the United States attorney for western Michigan was instructed by the Department of Justice to apply for an injunction restraining the mill-owners from dumping débris into Portage Lake between the harbor lines established by the Secretary of War.

(See Appendix H H 11.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examination of *Black River, Lake Superior, Michigan, to deepen channel to depth of 16 feet and constructing a break-water*, was made by the local engineer in charge. Major Quinn, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers concurring in the conclusion reached in this instance, has given no instructions to make further survey with the view to its improvement.

(See Appendix H H 10.)

It appearing from the report of the preliminary examination made by the local engineer that the following localities are worthy of improvement, and the public necessity therefor being apparent from the facts and reasons reported, which are concurred in by the Chief of Engineers, Major Quinn was charged with their survey, the results of which will be submitted when received.

1. *Duluth, Minnesota.*

2. *Minnesota Point, at Superior, at the west end of Lake Superior, Wisconsin, to ascertain what should be done to preserve the same from the inroads of the lake, and for the protection of the harbor.*

IMPROVEMENT OF HARBORS OF THE WEST SHORE OF LAKE MICHIGAN NORTH OF WAUKEGAN, ILLINOIS. IMPROVEMENT OF FOX AND WISCONSIN RIVERS.

Officer in charge, Maj. C. E. L. B. Davis, Corps of Engineers, with Lieut. G. D. Fitch, Corps of Engineers, under his immediate orders since August 24, 1888. Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. *Manistique Harbor, Michigan.*—The present project for the improvement of this harbor was adopted in 1880, and consisted in dredging between the piers built by the Chicago Lumbering Company, increasing the depth of the channel to 12 feet for a width of 150 feet.

The natural channel of entrance to the mouth of the Manistique River

was 7 feet deep. By private enterprise 3,000 feet of slab-piers had been built at the mouth of the river and a channel dredged to 10 feet before any appropriation had been made by the Government.

By the acts of 1880 and 1881 the sum of \$6,000 was appropriated for this harbor in order to dredge a channel 150 feet wide and 12 feet deep between the piers built by a local lumbering company. Dredging was done to the amount of 11,780 cubic yards, and the work was then suspended in consequence of the refusal of the company controlling the harbor to rectify their pier lines when rebuilding the same.

No work has been done during the year.

No appropriation is asked for this harbor.

July 1, 1888, amount available	\$3,101.79
July 1, 1889, balance available	3,101.79

(See Appendix I I 1.)

2. *Cedar River Harbor, Michigan.*—The present project for the improvement of this harbor was adopted in 1883, with a modification in the direction of the piers in 1884, the object being to afford a channel of entrance of navigable width and 14 feet in depth.

Previous to the improvement the mouth of the river was 175 feet wide and 8 to 10 feet deep with a 3-foot bar in front of the mouth. Improvements had been made by private parties prior to the commencement of Government work.

The amount expended to June 30, 1889, is \$27,664.98, and has resulted in the construction of two pile-piers 754 and 301 feet long, respectively, in continuation of the slab-docks built by private parties, and a channel that at last accounts, October, 1885, was 50 feet wide and 13 feet deep, and 100 feet wide for a depth of 11 feet.

July 1, 1888, amount available	\$2,335.02
July 1, 1889, balance available	2,335.02

{ Amount (estimated) required for completion of existing project.....	108,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix I I 2.)

3. *Menomonee Harbor, Michigan and Wisconsin.*—The present object for the improvement of this harbor was adopted in 1871 and modified in 1874, the object being to afford a channel of entrance of navigable width and not less than 14 feet depth.

Previous to the improvement of this harbor the depth of water at the mouth of the Menomonee River was about 4 feet, and the river was navigable for boats of that draught for some 2 miles above its mouth.

The amount expended to June 30, 1889, is \$200,933.26, and has resulted in the construction of two piers, with a dredged channel between, 14 feet deep and 270 feet wide, this channel extending across a bar about 350 feet beyond the south pier. The north pier consists of three parts, 585 feet of slab-pier, 609 feet of pile-pier, and 660 feet of cribs, or a total of 1,854 feet. The south pier consists of 1,900 feet of pile-pier and 810 feet of cribs, making a total of 2,710 feet.

July 1, 1888, amount available	\$2,370.30
Fuel sold to officers, deposited to credit of appropriation	20.00
Amount appropriated by act of August 11, 1838	9,000.00

11,390.30

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	316.46
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July 1, 1889, balance available	11,073.84
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(See Appendix I I 3.)

4. *Oconto Harbor, Wisconsin.*—In its natural condition the channel at the entrance to Oconto River was obstructed by a bar, with less than 2 feet of water over it. Previous to 1881, when the first appropriation was made for its improvement, the citizens had, by the construction of a small amount of slab pier and by dredging, increased the depth to 3½ feet.

The project of improvement proposes to secure an 8 foot channel from deep water in Green Bay to the city of Oconto, by dredging and the construction of piers, at an estimated cost of \$150,000.

During the fiscal year ending June 30, 1889, 650 feet of reinforcement piling on the channel side of the south pier was built by hired labor.

The total amount expended to June 30, 1889, is \$51,992.17, resulting in the building of two piers, the north pier 1,603 feet and the south one 2,151 feet in length, the latter being the full length contemplated by the approved project, and in the removal of 207,641 cubic yards of material by dredging.

The navigation interests at Oconto are at present dependent upon the business of three lumber companies located there, and the benefits to be obtained are essentially local.

July 1, 1888, amount available.....	\$199. 64
Amount appropriated by act of August 11, 1888.....	20, 000. 00
	<hr/> 20, 199. 64
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	4, 213. 31
	<hr/> 15, 986. 33
{ Amount (estimated) required for completion of existing project.....	82, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix I I 4.)	

5. *Pensaukee Harbor, Wisconsin.*—The first appropriation for this harbor was made in 1882. At that time the facilities of the natural channel of the Pensaukee River had been increased by private enterprise by the construction of 1,600 linear feet of continuous slab pier and by dredging from a depth of 2 feet to a depth varying from 7 to 9 feet, with a width of 30 feet.

The project of improvement of this harbor, adopted in 1883, consists in the construction of a single slab pier 2,500 feet in length, in continuation of the pier built by private enterprise, and the dredging of a channel 10 feet deep and 100 feet wide on the south side of the pier.

There was no work done at this harbor during the fiscal year.

The total amount expended to June 30, 1889, is \$10,939.08, resulting in the construction of 1,300 feet of the proposed extension of the pier and the dredging of 5,698 cubic yards of material, making a channel 25 feet wide and 10 feet deep. The entire length of the pier is 2,900 feet, the inshore 1,600 feet having been built by private enterprise.

There being at present no commercial or navigation interests to be benefited by improving the harbor, and the harbor itself not being needed as a harbor of refuge, further operations have been suspended.

July 1, 1888, amount available.....	\$4, 059. 92
July 1, 1889, balance available.....	4, 059. 92
	<hr/> 8, 119. 84
{ Amount (estimated) required for completion of existing project.....	35, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix I I 5.)	

6. *Green Bay Harbor, Wisconsin.*—Before the improvement of this harbor was begun, the channel between the mouth of Fox River and the deep water in Green Bay was circuitous and narrow, with but 6 feet of water at its shoalest point.

The project was adopted in 1866 and modified in 1872 and 1874, its object being to secure a channel 200 feet wide, 14 feet deep, and 2 miles long, in place of the natural channel, with a revetted cut across Grassy Island.

During the fiscal year ending June 30, 1889, no work was done.

The total expenditures since the beginning of the improvement amount to \$277,523.47, resulting in a dredged channel 10,600 feet long, 200 feet wide, and 14 feet deep, except where occasional shoals reduce the depth to 13 feet, and the construction of 1,325 linear feet of pile and timber revetment on the sides of the cut through Grassy Island.

The appropriation asked for will be applied to dredging the channel to the dimensions called for by the present project.

July 1, 1888, amount available	\$208.03
Amount appropriated by act of August 11, 1888.....	10,000.00
	<hr/> 10,208.03
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	150.50
	<hr/> 10,057.53
Amount (estimated) required for completion of existing project.....	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix I I 6.)

7. *Harbor of Refuge at entrance of Sturgeon Bay Canal, Wisconsin.*—Before the construction of this harbor was undertaken the Lake Michigan entrance to the Sturgeon Bay and Lake Michigan Ship Canal was entirely unprotected from storms ranging from northeast to southwest.

The project of constructing a harbor of refuge at this point was adopted in 1873 and modified in 1879 and 1880. The modified project, as carried out, consists of two piers, each 1,344 feet long, 850 feet apart at the shore line, protecting the lake entrance of the canal, and converging so as to make the harbor entrance 335 feet wide, inclosing an area of about 10 acres.

No work was done during the fiscal year ending June 30, 1889.

The total expenditure at this harbor since the beginning of the improvement has been \$161,428.58, resulting in the entire completion of the piers as projected, and in the dredging of 132,344 cubic yards of material, giving a channel nearly 16 feet deep at the entrance and 14 feet or more thence to the canal, making a depth of 14 feet over the greater part of the sheltered area.

The appropriation asked for will be applied to the maintenance of the channel and piers.

July 1, 1888, amount available.....	\$3,640.42
July 1, 1889, amount expended during fiscal year exclusive of liabilities outstanding July 1, 1888	74.00
	<hr/> 3,566.42
July 1, 1889, balance available	<hr/> 3,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	
{ Submitted in compliance with requirements of sections 2 of river and	
{ harbor acts of 1866 and 1867.	

(See Appendix I I 7.)

8. *Ahnapee Harbor, Wisconsin.*—Previous to the improvement of this harbor the depth of water at the mouth of the Wolf River was only about 2 feet.

The project of improvement adopted in 1875 and modified in 1884 provided for the formation of a small artificial harbor, connected with the lake by a channel 100 feet wide and 12 feet deep, formed by the construction of two piers extending to the 18-foot contour, with a 200-foot entrance between the pier-heads.

During the fiscal year ending June 30, 1889, 3,489 cubic yards of rock and 19,965 cubic yards of sand have been removed from the channel; one crib in the south pier moved from its place by a storm has been reset; 250 linear feet of superstructure has been rebuilt and 200 feet extension of north pier commenced, all work being done by hired labor and open purchase.

The total amount expended to June 30, 1889, is \$154,189.94, and has resulted in the construction of two piers, the north one 1,052 feet long, and the south one 1,125 feet, and in the removal of 25,741 cubic yards of rock and 102,308 cubic yards of sand.

July 1, 1888, amount available	\$15,274.62
Amount appropriated by act of August 11, 1888	5,000.00

20,274.62

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$14,529.06
July 1, 1889, outstanding liabilities	478.83

15,007.89

July 1, 1889, balance available	5,266.73
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{ Amount (estimated) required for completion of existing project	15,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix I I 8.)

9. *Kewaunee Harbor, Wisconsin.*—The natural entrance to this harbor was via the Kewaunee River. The river mouth was not more than 20 feet wide, with a depth of about 2 feet at its shoalest point, and obstructed by submerged bowlders.

The project of improvement was adopted in 1881. Its design was to cut a channel through a neck of land between the river and the lake at a point about 2,000 feet south of the river mouth, and to continue this channel to deep water in the lake by the construction of two parallel piers 200 feet apart, extending from each side of the cut lakeward to the 18 foot contour.

During the fiscal year ending June 30, 1889, 7,280 cubic yards of material have been removed from the channel and 5,231 cubic yards from the inner harbor by the government dredge.

By contract calling for 300 feet extension of the south pier 100 feet was nearly completed on the above-mentioned date.

The total amount expended to June 30, 1889, has been \$46,297.59, in addition to which the local harbor commissioners have expended \$8,042.72. These expenditures have resulted in the construction of 1,000 feet of north pier and 775 feet of south pier, and in the dredging of a channel 100 feet wide and 10 to 12 feet deep, 16,315 cubic yards of material having been removed by the government dredges.

July 1, 1886, amount available	\$189.37
Amount appropriated by act of August 11, 1888	10,000.00
	<hr/> 10,189.37
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$1,521.36
July 1, 1889, amount covered by existing contracts.....	8,000.00
	<hr/> 9,521.36
July 1, 1889, balance available	<hr/> 668.01
{ Amount (estimated) required for completion of existing project.....	137,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	30,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix I I 9.)	

10. *Two Rivers Harbor, Wisconsin*.—Previous to the improvement of this harbor the natural channel was obstructed by a bar covered by but 2 or 3 feet of water.

The project of improvement adopted in 1870 provided for the formation of a channel of navigable width and not less than 12 feet deep. This was to be accomplished by the construction of two piers extending from the river mouth lakeward to the 18-foot contour in Lake Michigan and by dredging between them.

During the fiscal year ending June 30, 1889, 12,772 cubic yards of material was removed from the channel by a Government dredge, thus restoring the depth to 12 feet.

The total expenditures to June 30, 1889, are \$199,260.63, resulting in the construction of two parallel piers, as follows: A north pier 1,810 feet long, the inner 1,060 linear feet of which consists of pile-pier, and the outer 750 feet of crib-pier; a south pier 1,710 feet long, 960 linear feet of which is pile-pier, and the outer 750 feet crib-pier; the crib sections of the two piers begin at points opposite, and are 230 feet apart. The pile sections are 270 feet apart; 253,372 cubic yards of material has been removed by dredging.

It is proposed to expend the small appropriation asked for in repairs to piers and dredging, if necessary.

July 1, 1888, amount available.....	\$135.33
Amount appropriated by act of August 11, 1888	2,500.00
	<hr/> 2,635.33
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	1,395.96
July 1, 1889, balance available	<hr/> 1,239.37
{ Amount (estimated) required for completion of existing project.....	65,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	3,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix II 10.)	

11. *Manitowoc Harbor, Wisconsin*.—Previous to the improvement of this harbor but 3 feet of water existed at the shoalest point over the bar at the mouth of the Manitowoc River.

The original project adopted in 1852 provided for the construction of two parallel piers 220 feet apart, and extending from the river mouth to the 12-foot contour in Lake Michigan. This was modified in 1881 to extending the piers to the 18½-foot contour and obtaining a channel not less than 14 feet deep.

Considerable shoaling having taken place during the fiscal year ending June 30, 1889, 28,120 cubic yards of material was removed from the channel by the Government dredge, thus restoring the depth to 14 feet.

Under contract 401 linear feet of the south pier was rebuilt above the water-line.

The total amount expended to June 30, 1889, is \$298,898.89, and has resulted in the construction of two piers 1,970 and 1,900 feet long, 228 feet apart at the shore-line, and 250 feet at the outer ends, and in the dredging of 184,997 cubic yards of material.

It is proposed to expend the appropriation asked for in rebuilding the inner ends of the piers above the water-line.

July 1, 1888, amount available.....	\$488.85
Amount appropriated by act of August 11, 1888.....	8,000.00
	<hr/>
	8,488.85
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	7,515.74
	<hr/>
July 1, 1889, balance available.....	973.11
	<hr/>
{ Amount (estimated) required for completion of existing project	8,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	8,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix I I I 1.)	

12. *Sheboygan Harbor, Wisconsin.*—Previous to the improvement of this harbor the natural channel had a depth not exceeding 4 feet on the bar at the entrance to the river.

The project for the improvement of this harbor was adopted in 1852 and had for its object the formation of a 12-foot channel entrance to the mouth of the Sheboygan River. This was modified in 1873 so as to secure a deeper channel by further pier extension and dredging. Both projects were completed within their estimated cost and a channel was formed 100 feet wide with a depth of 15 to 16 feet between the piers. The existing project was adopted in 1881, its object being to deepen the channel still further by extending the piers to the 20-foot contour in the lake and dredging to a depth of 18 feet between their outer ends, the depth decreasing to 14 feet at the shore-line. There is now a navigable channel with a depth of 14 feet.

During the fiscal year ending June 30, 1889, 20,150 cubic yards of material was removed from the channel by a Government dredge.

At the close of the fiscal year the south pier was being extended 200 feet by contract.

The total expenditures to June 30, 1889, have amounted to \$289,770.86, and have resulted in the construction of two piers 2,044 and 2,260 feet long, respectively, built of cribs (except less than 300 feet at the shore end), of widths of from 14 to 20 feet, and in dredging 207,193 cubic yards of material from the channel.

The only means of securing a permanent channel is by rapid extension of the piers to deep water; hence a liberal appropriation is urged as a matter of economy and of necessity to the commerce of this important harbor.

July 1, 1888, amount available.....	\$629.35
Amount appropriated by act of August 11, 1888	15,000.00
	<hr/>
	15,629.35
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$2,011.50
July 1, 1889, amount covered by existing contracts.....	11,000.00
	<hr/>
	13,011.50
July 1, 1889, balance available.....	<hr/>
	2,617.85

{ Amount (estimated) required for completion of existing project.....	\$32,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	30,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix I I 12.)

13. *Port Washington Harbor, Wisconsin.*—The present project for the improvement of this harbor, adopted in 1869 and modified in 1870 and 1876, was for the formation by dredging of two interior basins, having a combined area of about 5½ acres, with a depth of 12 feet, and a channel of the same depth connecting them with the lake, the channel entrance to the basins to be north of the mouth of the Sauk River, inclosed between two piers.

The natural channel at the month of the Sauk River was narrow, and at the shoalest point had a depth of but 1 foot.

At the close of the fiscal year ending June 30, 1889, dredging was being done at this harbor, and on the above-mentioned date 3,510 cubic yards of material had been removed.

The amount expended to June 30, 1889, is \$169,161.54, and has resulted in the construction of a north and south pier 920 and 1,226 feet long, respectively, with 400 feet revetment along the north bank of the river, extending to the inner end of the south pier; in the formation of two interior dredged basins of 2½ and 3 acres, respectively, with an average depth of about 9 feet in the north and 8 feet in the west basin, and in making a navigable channel between the piers of 11 feet.

It is proposed to extend the appropriation asked for in completing the south pier and maintenance of works.

July 1, 1888, amount available.....	\$1,039.37
Amount appropriated by act of August 11, 1888.....	5,000.00
	<hr/> 6,039.37
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	693.01
July 1, 1889, balance available.....	<hr/> 5,346.36

{ Amount (estimated) required for completion of existing project.....	7,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	7,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix I I 13.)

14. *Harbor of refuge at Milwaukee Bay, Wisconsin.*—In charge of Capt. W. L. Marshall, Corps of Engineers, until September 19, 1888.—The project for the work was approved in 1881, and contemplated the formation of an artificial harbor by inclosing a portion of Lake Michigan within an outer breakwater of crib-work upon a stone foundation. This harbor will furnish 417 acres of safe mooring ground beyond the 18-foot contour and about twice this area beyond the 12-foot contour.

Work began in 1881, and up to June 30, 1889, there has been expended \$360,812.22, resulting in the completion of 3,550 linear feet of the substructure of the breakwater, over which 3,100 linear feet of superstructure has been built.

During the fiscal year ending June 30, 1889, 250 feet of substructure has been built.

The breakwater when completed will be 7,250 feet in length. There remains, then, to be constructed 3,700 linear feet of substructure and 4,150 linear feet of superstructure to complete the work.

The funds asked for are to be applied to the extension of the breakwater.

The harbor is now used to a limited extent as a shelter from northeast storms. Its value will rapidly increase as the east arm is extended.

July 1, 1888, amount available	\$3,638.23
Amount appropriated by act of August 11, 1888	70,000.00

73,638.23

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$30,249.88
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July 1, 1889, amount covered by existing contracts	37,155.11
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67,404.99

July 1, 1889, balance available	6,233.24
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{ Amount (estimated) required for completion of existing project	418,000.00
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{ Amount that can be profitably expended in fiscal year ending June 30, 1891	150,000.00
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{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
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(See Appendix I I 14.)

15. *Milwaukee Harbor, Wisconsin.*—In charge of Capt. W. L. Marshall, Corps of Engineers, until September 19, 1888. The present project was adopted in 1852, and was directed to securing 12 feet of water at the entrance to the river and to protecting this channel by parallel piers. Since that date a channel, 18 feet in depth and of sufficient width, has been formed by extending the piers and dredging. The project has been completed, and consequently the only expenditures now demanded are for the maintenance of the piers by timely repairs and the depth of the channel by dredging.

The original depth of water at the mouth of the river was not more than 3½ feet.

The United States has expended on this harbor up to June 30, 1889, \$294,103.87, in addition to \$321,355.66 by the city of Milwaukee.

During the fiscal year ending June 30, 1889, 340 linear feet of superstructure over the outer section of the south pier has been cut down and rebuilt.

The stone superstructure of the north pier and the concrete paving need repairing. Repairs are also needed at the inshore ends of both piers. No dredging has been done at this harbor since 1880, and the channel has narrowed and shoaled somewhat. It will require the removal of some 30,000 cubic yards of material to restore the channel to its projected dimensions.

It is intended to apply the appropriation asked for to the above-mentioned repairs and dredging.

Amount appropriated by act of August 11, 1888	\$10,000.00
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July 1, 1889, amount expended during fiscal year, exclusive of	
--	--

liabilities outstanding July 1, 1888	\$4,517.79
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July 1, 1889, amount covered by existing contracts	4,155.87
--	----------

8,673.66

July 1, 1889, balance available	1,326.34
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{ Amount (estimated) required for completion of existing project	20,000.00
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{ Amount that can be profitably expended in fiscal year ending June 30, 1891	15,000.00
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{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
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(See Appendix I I 15.)

16. *Racine Harbor, Wisconsin.*—In charge of Capt. W. L. Marshall, Corps of Engineers, until September 19, 1888. The entrance to this harbor originally varied in depth from absolute closure after storms to about 6 feet.

The original project was adopted in 1843 and contemplated a channel 12 feet deep. In 1866 the project was modified to providing a channel 15 feet deep.

There has been expended on this harbor up to June 30, 1889, \$238,706.55, resulting in a north and south pier, 1,460 and 1,070 feet in length, respectively, and a channel 16 feet in depth.

During the past fiscal year the channel, which had shoaled to barely 12½ feet, was dredged out to 16 feet, thus restoring it to the projected dimensions, 36,356 cubic yards of material being removed by contract.

The constant shoaling at the entrance to this harbor shows that the piers will have to be extended several hundred feet in order to maintain the intended depth of 16 feet. Some 500 feet of the superstructure of the piers needs rebuilding.

It is proposed to expend the appropriation asked for in the above mentioned repairs and pier extension.

July 1, 1888, amount available.....	\$599.48
Amount appropriated by act of August 11, 1888.....	10,000.00
	<hr/> 10,599.48
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	6,909.53
	<hr/> 3,699.95
{ Amount (estimated) required for completion of existing project.....	82,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	25,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix I I 16.)

17. *Kenosha Harbor, Wisconsin.*—In charge of Capt. W. L. Marshall, Corps of Engineers, until September 19, 1888. The plan of improvement by parallel piers and dredging was adopted in 1852, and was first directed to securing a channel 12 feet deep. This was modified in 1866 so as to secure a channel 15 feet deep. The original depth was 4 feet or less; sometimes the mouth of Pike Creek was entirely closed.

In 1875 and 1876 this harbor was dredged to 15 feet, but the appropriations have been insufficient to maintain this depth, so that the periodical dredging has only provided an available channel of about 12 feet.

During the fiscal year ending June 30, 1889, nearly 25,000 cubic yards of material has been dredged from the channel between the piers, by contract, thus restoring the channel to a uniform depth of 15 feet. The contract was completed November 30, 1888, and soundings made in May, 1889, showed that a bar had reformed across the front of the harbor with a least depth of 9.8 feet. Arrangements have been made for removing this bar.

The only method of preventing this reforming of the bar is to extend the piers, and it is proposed to expend the appropriation asked for in this pier extension and in repairs to superstructure.

There has been expended on this harbor up to June 30, 1889, \$226,586.71, resulting in the construction of two piers, north and south, being respectively 1,600 and 800 feet in length, and a channel of varying depth.

July 1, 1888, amount available.....	\$799.93
Amount appropriated by act of August 11, 1888.....	7,500.00
	<hr/> 8,299.93
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	5,443.07
	<hr/> 2,856.86

{ Amount (estimated) required for completion of existing project.....	\$82,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	30,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix I I 17.)

18. *Waukegan Harbor, Illinois.* In charge of Capt. W. L. Marshall, Corps of Engineers, until September 19, 1888.—The present project was adopted in 1880, and, as since modified, consists in excavating a small basin in the low ground between the lake and the bluffs to form the harbor, and in dredging an entrance between piers from the lake to the basin.

During the fiscal year ending June 30, 1889, by hired labor the south pier was extended 248 feet. A contract was entered into for dredging the entrance channel and interior basin and on the above-mentioned date 17,805 cubic yards of material had been removed.

There has been expended on this harbor up to the close of the fiscal year \$100,765.37, resulting in the construction of a total length of pile pier-work of 2,284.5 feet and the removal of the 17,805 cubic yards of material.

The prolongation of the fore-shore on the north side of the harbor will necessitate a material extension of the entrance piers, and it is proposed to expend the appropriation asked for in pier extension and the further prosecution of the approved project.

July 1, 1888, amount available	\$274.80
Amount appropriated by act of August 11, 1888.....	25,000.00

25,274.80

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....

\$11,040.17

July 1, 1889, amount covered by existing contracts.....

7,076.96

18,117.13

July 1, 1889, balance available

7,157.67

{ Amount (estimated) required for completion of existing project.....	121,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	50,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix I I 18.)

19. *Fox and Wisconsin Rivers, Wisconsin.*—In charge of Capt. W. L. Marshall, Corps of Engineers, until September 19, 1888. The works for the improvement of the Fox and Wisconsin rivers were purchased by the United States from the Green Bay and Mississippi Canal Company in 1872. These works were all, except one stone lock, temporary structures, all of them in bad condition. There was no low-water navigation on the Upper Fox, and on the Lower Fox navigation was uncertain.

For the Fox River.—The adopted project contemplated the replacing of the temporary structures with permanent works, the construction of five additional stone locks on the Upper Fox, and widening and deepening the channels throughout the river and canals to 6 feet depth and 100 feet width.

For the Wisconsin River.—The method adopted has been to contract the channel-way by wing dams of brush and stone, to give increased depth by concentrating the water and by scour due to the increased currents. The estimate, including the Wisconsin River, made in 1874

and 1876, was \$3,745,663, since which time there has been appropriated \$1,780,000, leaving for completion of the adopted project \$1,965,663.

The general subject of the improvement of the Fox and Wisconsin rivers was referred to The Board of Engineers, which, after systematic observations of the effect of the dams on the improved section of the Wisconsin River, submitted a report contained in House Ex. Doc. No. 65, Forty-ninth Congress, second session, recommending that no further work be done on wing-dams in the Wisconsin River with a view to improving its navigation.

The original project, therefore, as far as it relates to the Wisconsin River, has been abandoned, and the work confined to the Fox River, under the modified project of a Board of Engineers submitted September 17, 1884, published in the Annual Report of the Chief of Engineers for 1885, approved by the Secretary of War, December 10, 1884, as further modified by authority of the Chief of Engineers, May 14, 1886.

The modified project applies only to the Fox River and its needs, and contemplates the renovation of eleven old locks and the deepening and widening the channel of the Fox River from Montello to Green Bay to 6 feet depth and 100 feet width, the estimate for which is \$602,000.

The amount expended on the improvement of the Fox and Wisconsin rivers, from 1867 to date, including outstanding liabilities and \$145,000 paid to the Green Bay and Mississippi Canal Company for works of improvement under act of June 10, 1872, is \$2,754,873.13.

The result of this expenditure has been :

On the Fox River.—The construction of 14 new locks of stone; 13 dams, 4 of which are temporary; 12 cut-offs; 10 miles of canals dredged and deepened. Over 2,000,000 cubic yards of material has been dredged from the Upper Fox, and all temporary structures repaired and maintained in working order. The navigation has thus been continuous throughout the season from Portage to Green Bay, there being at an ordinary stage of water 2½ feet navigation on the Upper Fox, and 5¼ feet on the Lower Fox, except at the entrance of Lake Winnebago, where there is only 4½ feet. During the season from July to November, 1888, navigation was partially suspended from Lake Winnebago to Appleton, due to the mills drawing more water than the discharge of the Fox River, thus lowering the levels of the Lake Winnebago and Little Butte des Morts pools.

Under the modified project there remains to be done 2,800,000 cubic yards of dredging and rock excavation, mainly upon the Upper Fox, and one dam at Appleton, with sluice-ways, the old works to be maintained under the continuous appropriation.

During the fiscal year ending June 30, 1889, the following work has been done :

On the Upper Fox.—The work was confined to the maintenance of the channel by dredging, and to timely repairs to locks, dams, and embankments.

On the Lower Fox.—Dredging was continued in the Menasha Channel, to connect the deep-rock cut with deep water in the lake.

The various works on the Lower Fox were maintained in serviceable condition.

Extensive repairs were made to dredging plant, and to Rapid Croche and Menasha locks. Good progress was made in the construction of the Appleton lower dam, and general repairs made to locks, dams, and canal banks.

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July 1, 1888, amount available.....	\$19,839.61
Fuel sold to officers, deposited to credit of appropriation.....	190.50
Amount appropriated by act of August 11, 1888.....	100,000.00

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$61,869.51	120,130.11
July 1, 1889, outstanding liabilities.....	1.25	
		61,870.76

July 1, 1889, balance available.....	58,259.35
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{ Amount (estimated) required for completion of existing project.....	446,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	200,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix II 19.)

20. *Operating and care of locks and dams on the Fox and Wisconsin rivers, Wisconsin.*—In charge of Capt. W. L. Marshall, Corps of Engineers, until September 19, 1888. Under the continuous appropriation for operating and care of canals and other works of navigation, it is proposed to maintain existing navigation by timely repairs to old locks until they are replaced by new, and to continue the repairs of works that have already been completed and used, injured by the extraordinary flood of 1881.

The amount expended during the fiscal year ending June 30, 1889, is \$48,329.62.

(See Appendix I I 20.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examinations of the following localities were made by the local engineer in charge, Major Davis, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers concurring in the conclusions reached in these instances, has given no instructions to make further survey with the view to their improvement.

1. *Centreville Creek, Manitowoc County, Wisconsin.*—(See Appendix I I 21.)

2. *Kenosha Harbor, Wisconsin, for refuge.*—(See Appendix I I 22.)

3. *Oconto Harbor, Wisconsin, channel 16 feet deep and 75 feet wide from piers to first contour in river at Spies Slough.*—(See Appendix I I 23.)

The required preliminary examination of *Rucine Harbor, Wisconsin, enlarging and deepening channel*, was made by the local engineer, Major Davis, who states that under an existing contract made in October, 1888, it is thought a channel 16 feet deep and 150 feet wide will be dredged the whole length of the piers forming the harbor entrance. This, in his opinion, will give the needed relief by "enlarging and deepening the channel," as contemplated by the act. (See Appendix I I 24.)

Attention in this connection is invited to the report of the officer in charge of the improvement of this harbor (Appendix I I 16) and to the estimate therein submitted for extension of piers.

It appearing from the report of the preliminary examination made by the local engineer that the following localities are worthy of improvement, and the public necessity therefor being apparent from the facts and reasons reported, which are concurred in by the Chief of En-

gineers, Major Davis was charged with their survey, the results of which will be submitted when received.

1. *Harbor at mouth of Fond du Lac River, in Lake Winnebago, Wisconsin.*

2. *Menomonee Harbor, from the waters of Green Bay to N. Ludington & Company's mill, Wisconsin, for a channel 16 feet deep and 200 feet wide.*

IMPROVEMENT OF THE HARBORS OF CHICAGO AND CALUMET, ILLINOIS—IMPROVEMENT OF ILLINOIS AND CALUMET RIVERS—LOCATION OF THE ILLINOIS AND MISSISSIPPI CANAL.

Officer in charge, Capt. W. L. Marshall, Corps of Engineers, with Lieut. G. D. Fitch, Corps of Engineers, under his immediate orders, until August 24, 1888. Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. *Chicago Harbor, Illinois.*—The present project was adopted in 1870, and modified in 1878.

The project consists in :

The formation of an outer harbor or basin, by inclosing a portion of Lake Michigan just south of and adjoining the entrance to Chicago River, for the purpose of increasing the harbor facilities of the port of Chicago.

The construction of an exterior breakwater of crib-work filled with stone outside of the outer harbor in deep water to shelter the approach to the river and outer harbor entrances, and to form a harbor of refuge at the southern end of Lake Michigan.

There has been expended upon this project since 1870, \$1,465,215.43, and has resulted :

In the completion of the outer harbor, except 267,000 cubic yards of dredging, to attain 16 feet in depth throughout the basin required.

In the completion of 4,644 linear feet of the exterior breakwater.

During the past fiscal year the work consisted in :

(a) *Exterior breakwater.*—The completion by contract of 400 linear feet of superstructure over the outer extremity of the exterior breakwater for the harbor of refuge, and in building and placing upon a stone foundation six cribs, each 68 feet long by 30 feet wide, resulting in the extension of the substructure of the exterior breakwater 408 linear feet. Under the present contract eleven additional cribs are to be placed, completing the substructure of the exterior breakwater.

(b) *Outer basin.*—The old crib-work at the gap produced in the southerly breakwater by the storm of December 4, 1885, as far as it would impede the work of repairing this break, was broken to pieces by blasting with forcite, and the débris dredged out of the way. Four cribs, each 100 feet long, 16 feet in width, and 10 feet in height, were built to be placed in this gap ; but have not yet been sunk.

(c) *Dredging in harbor entrance.*—Twenty-five thousand two hundred and eighty-two cubic yards of material was dredged under contract, from the entrance to Chicago River, restoring the depth to 16 feet.

To complete the work of improvement upon the exterior breakwater and inner basin requires, in addition to the funds now on hand, \$52,000.

The whole of the superstructure over the easterly breakwater of the outer basin, and over part of the north pier of the entrance to Chicago River is now in an unsafe and rotten condition, and requires renewal.

One hundred and twenty thousand dollars is required to build these superstructures.

The dredging in the outer basin is not urgent, and can be postponed until the basin is demanded for harbor and dock purposes, when the material will be valuable for filling. It should not be further dredged and wasted.

Estimated for the completion of outer basin and exterior breakwater....	\$52,000.00
Estimated for superstructure over easterly breakwater, outer harbor, and north pier	120,000.00
Total	172,000.00
July 1, 1888, amount available	2,933.30
Received from sale of fuel to officer.....	24.75
Amount appropriated by act of August 11, 1888	200,000.00
	202,958.05
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$55,568.41
July 1, 1889, amount covered by existing contracts.....	82,197.52
	137,765.93
July 1, 1889, balance available	65,192.12
{ Amount (estimated) required for completion of existing project..... 172,000.00 Amount that can be profitably expended in fiscal year ending June 30, 1891 172,000.00 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix J J 1.)	

2. *Calumet Harbor, Illinois.*—This improvement is to furnish a safe and practicable entrance to Calumet River and the port of South Chicago by parallel piers, 300 feet apart, extending from shore to deep water in the lake, and by dredging between them to 16 feet in depth at low water.

The work commenced in 1870, and at the close of the fiscal year 1889 there had been expended \$407,393.21, as the result of which 3,640 linear feet of the north pier and 2,020 linear feet of the south pier are completed, and 384,346 cubic yards of material dredged, giving a channel 16 feet in depth instead of 7 feet, as found here before improvement.

During the past year two cribs—completing the south pier and the present project, as far as the piers are concerned—have been placed upon pile foundations, and 922.15 cords of stone was placed in the cribs of the north and south piers. The crib-work was done under contract with H. B. Herr & Co., and the stone filling by purchase in open market.

Additional dredging is necessary to restore the channel, which has deteriorated, to 16 feet in depth.

The superstructure on portions of the north and south piers is rotten for a length of 1,600 linear feet, and requires renewal.

The south pier should be extended 800 linear feet, to prevent sands drifting into the channel, and there is a demand to accommodate heavily laden boats carrying iron-ore that the channel be dredged to 18 feet in depth.

The funds now available and those asked for the fiscal year ending June 30, 1891, are to be applied to the following purposes:

For dredging in channel	\$21,000
For building superstructure	26,000

all of which can be expended profitably in one year. This work is now urgent. To extend the south pier 800 feet, as herein recommended, will require a further sum of \$52,800; but this part of the work may be de-

layed until the work of maintenance, which has become absolutely necessary, has been appropriated for and done.

July 1, 1888, amount available	\$777.70
Amount appropriated by act of August 11, 1888.....	20,400.00
	<hr/>
	21,177.70
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	16,170.91
	<hr/>
July 1, 1889, balance available	5,006.79
	<hr/>
{ Amount (estimated) required for maintenance	47,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	47,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1877.	
(See Appendix J J 2.)	

3. *Illinois River, Illinois.*—The present project contemplates the extension of the work heretofore done by the State of Illinois from the mouth of Copperas Creek to the Mississippi River, a distance of 135 miles, which project includes the building of two locks 350 feet long, 75 feet wide, and with 7 feet at low water over the miter-sills, and dredging the channels where necessary to 7 feet deep at low water.

The sites selected for the two locks are, one at Kampsville, 30 miles above the mouth of the Illinois, the other at La Grange, 45 miles above Kampsville.

The ultimate object of the improvement is the construction of a ship-canal from the southern end of Lake Michigan to the Mississippi River of sufficient capacity to accommodate large-sized Mississippi steamboats, and for military and naval purposes.

The State of Illinois, aided by the United States, has executed part of this project by the construction of two locks of the dimensions above stated, one at Henry, and one at Copperas Creek, completing that part of the improvement between La Salle, Ill., and the mouth of Copperas Creek.

The La Grange Lock is now completed, with the exception of guide-piers. The foundation of the Kampsville Lock is completed, and the greater part of the stone cut and delivered. Both dams are still to be constructed, the Kampsville Lock completed, and dredging done amounting to more than 2,000,000 cubic yards. In executing this work the United States has expended up to the close of the fiscal year ending June 30, 1889, \$807,425.99, exclusive of \$62,359.80 expended on the foundation of the Copperas Creek Lock, which was afterwards completed by the State of Illinois. An additional amount of \$747,747 was expended by the State of Illinois on Henry and Copperas Creek locks. To complete the present project requires the sum (estimated) of \$412,500.

During the fiscal year ending June 30, 1889, the following work was done:

(a) *La Grange Lock.*—Agreements have been made for all the material required for the dam across the Illinois River at this point, and 277,024 feet B. M. lumber and 57,506 pounds of iron have been received under these agreements. The site of the base of the dam has been dredged. The filling at the head wall of the lock behind the land-wall has been placed; 3,419 cubic yards has been dredged at the lower end of the lock, and preparations made to construct the dam at this point as soon as the stage of water will allow.

{ Amount (estimated) required for completion of existing project.....\$870,000.00
 { Amount that can be profitably expended in fiscal year ending June 30, 1891 100,000.00
 { Submitted in compliance with the requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix J J 4.)

5. *Location of the Illinois and Mississippi Canal.*—This work was directed by the river and harbor act of August 11, 1888, and has consisted in the location upon maps compiled from former surveys along “the line approved by the Secretary of War,” of a canal from the “Illinois River at or near the town of Hennepin, to the Mississippi River at or above the mouth of Rock River, together with a necessary feeder for the same,” to be “80 feet wide at the water-surface, and to have a depth of not less than 7 feet of water, with locks 170 feet long and 30 feet wide;” also “detailed plans and estimates for the construction of said canal and feeder.”

“The line approved by the Secretary of War” was designated by indorsement October 27, 1888, to be the route known in former reports upon the “Hennepin Canal” as the “Rock Island route.”

In locating the proposed canal, the route via Penney’s Slough and Rock River has been taken as the most economical and capacious, and during the past fiscal year work has been continuously carried on since December, 1888, in this office, preparing the necessary maps, plans, and estimates.

In proceeding with the designing and drawing the details of the mechanical constructions required on the line it was discovered that additional surveys would be required at several points on the line, notably of Bureau Creek Valley, and in the vicinity of the mouth of Rock River, and at Dixon, the point where the necessary feeder leaves Rock River. With exception of such detached local surveys, no additional surveys will probably be necessary.

During the past fiscal year the following work has been done:

A resurvey of Bureau Creek Valley was made, and the maps thereof drawn for the location of the Illinois and Mississippi Canal “to a scale of 1”=600’ upon sheets of uniform size, 30 inches by 40 inches; thirteen sheets were completed, each embracing 4 miles of the proposed canal.

Detailed drawings of locks, eight sheets were completed.

Details of aqueduct bridges, five sheets were completed.

Details of culverts, two sheets were completed.

Estimates have also been made for the locks and aqueduct bridges, as drawn; also, six sheets showing sites of aqueduct bridges; six sheets showing profiles of same; one sheet showing sites for Locks Nos. 28 and 29; one sheet showing profile of same; one sheet showing Pond Creek Valley. These latter sheets are on a larger scale than the general maps showing the location of the canal.

In all, it is estimated that an atlas of seventy-two sheets will be required, together with descriptive memoir and specifications, to complete the work.

The amount of work, draughting and designing all details of constructions, for a canal involving so many mechanical constructions; locks of various lifts for both canal and river navigation, dams, aqueduct bridges, culverts, highway and railway bridges, feeders, weirs, etc., is very great, and it is expected that it will require the work of the present force quite the entire fiscal year ending June 30, 1890, to complete them.

The funds available will be sufficient to complete the work, and will be applied to that end during the fiscal year ending June 30, 1890.

No further appropriation is necessary.

July 1, 1888, amount available.....	\$14,497.44
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	4,761.61
July 1, 1889, balance available.....	9,735.83

(See Appendix J J 5.)

**EXAMINATIONS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS
OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.**

The required preliminary examinations of the following localities were made by the local engineer in charge, Captain Marshall, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers concurring in the conclusions reached in these instances, has given no instructions to make further survey with the view to their improvement:

1. *Grand Calumet River, Indiana, beginning one-half mile east of Hammond, and thence eastward to Lake Michigan.*—(See Appendix J J 6.)
2. *Canal-way connecting the waters of Lake Michigan with the Calumet River, beginning at a point on the Calumet River one mile east of Hammond, Indiana, and running due north to Berry Lake, and thence along the eastern waters of said Berry Lake; thence northeast to Lake Michigan.*—(See Appendix J J 7.)
3. *Berry Lake, Indiana, forming a natural harbor of refuge.*—(See Appendix J J 8.)

The local engineer, Captain Marshall, reports the *Grand Calumet River, Illinois*, as worthy of improvement, but that no further examination or survey of the stream is required or advisable, all necessary data for an estimate of cost of an improvement of any character having been already submitted to Congress, or being attainable. This conclusion was concurred in by the Chief of Engineers, and as the adopted project for the improvement of this stream under the appropriations of 1884, 1886, and 1888, includes that portion in Illinois, no further report or survey appeared to be necessary. The estimated cost of the improvement of the river from its mouth to one-half mile east of Hammond, Ind., is \$1,000,000. Of this amount \$130,000 has already been appropriated. (See Appendix J J 9.)

IMPROVEMENT OF HARBORS ON THE EASTERN SHORE OF LAKE MICHIGAN.

Officers in charge: Lieut. Col. S. M. Mansfield, Corps of Engineers, to December 18, 1888, since which date Maj. William Ludlow, Corps of Engineers, having under his immediate orders Lieut. J. E. Kuhn, Corps of Engineers. Division Engineer, Col. O. M. Poe, Corps of Engineers.

The local engineer invites attention to the necessity of making due provision for the dredging, which is a constant feature of the construction and maintenance of the harbors on the east coast of Lake Michigan, due to the sandy character of its shores and the constant movement of sand under the action of winds and waves. The estimates submitted include sand fences and sheet piling where requisite, and the procurement of a moderate dredging equipment for the fifteen harbors, covering 300 miles of coast, all of which require more or less dredging annually, for which, in most cases, private dredges, if obtainable at all, can only be had at high rates.

Attention is also invited to the desirability of legislation authorizing the Secretary of War to make and enforce regulations as to the speed of vessels through narrow channels where injury is done to the shore constructions by swift movements, and to protect the pier and revetments from fire thrown by passing tugs, etc., using slabs for fuel without a covering of wire over the smoke-stacks.

1. *Charlévoix Harbor and entrance to Pine Lake, Michigan.*—The average width of the original channel of entrance was 75 feet, and the depth varied from 2 to 6 feet. The present project for its improvement, adopted in 1868 and revised in 1875 and 1876, was to dredge a channel 100 to 150 feet wide, connecting Round Lake with Lake Michigan, to a depth of 12 feet, and to protect the banks with close piling, with crib-work beyond the shore-line in Lake Michigan. A further modification in 1882 provided for a revetted channel of the same depth and 83 feet wide between Round and Pine lakes.

The expenditures to June 30, 1888, were \$78,079.20.

The width at the entrance is 160 feet, reducing to 105 feet, and the depth varies from 10 to 16 feet. In the "upper channel," between Round and Pine lakes, the width between the revetments is 83 feet and the depth from 10 to 12 feet.

The expenditures during the fiscal year ended June 30, 1889, were \$2,738.54 for dredging in the channel to 13 feet. Contract was made for the construction of three additional 50-foot cribs in the south pier, which, at the close of the year, were nearly ready to be sunk in position.

During the present year repairs and dredging will be continued, and a portion of the "upper channel" revetted to cut off the flow of water in the old channel.

For year ending June 30, 1891, an estimate of \$22,000 is submitted to sheet pile the "upper channel," rebuild the south entrance revetment, and in part pay for and operate a dredging plant.

July 1, 1888, amount available.....	\$2,920.80
Amount appropriated by act of August 11, 1888.....	12,500.00

15,420.80

July 1, 1889, amount expended during fiscal year, exclusive of

liabilities outstanding July 1, 1888.....	\$2,171.69
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July 1, 1889, outstanding liabilities.....	558.85
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July 1, 1889, amount covered by existing contracts	8,595.30
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11,325.84

July 1, 1889, balance available	4,094.96
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{ Amount (estimated) required for completion of existing project	92,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	22,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix K K 1.)

2. *Frankfort Harbor, Michigan.*—The original channel between Lake Aux Bees Scies and Lake Michigan had but 3 or 4 feet of water.

The project of 1866 was to connect the two lakes by a 12-foot channel 200 feet in width, with suitable revetments and pier protection. In 1881 this was enlarged to extend the piers to 16 feet and reach rocky bottom free of sand.

To June 30, 1888, \$246,618.42 had been expended. The north pier still lacks 400 feet of its full length and the south pier 100 feet. The works generally are in good condition, and the channel depth varies from 10½ to 12½ feet. The south pier needs stone filling, and both re-

quire fences or other means to prevent sand blowing over them into the channel. A moderate amount of dredging is needed annually.

Work began in May, 1889, and was in progress at the close of the year. The Government dredge went to Frankfort in June and deepened the channel to 13 feet with a width of 25 feet. The expenditures for the fiscal year were \$1,313.90.

Contract was made for the construction of two additional cribs on the north pier, which will be put in this season, and extend the pier 100 feet.

For the year ending June 30, 1891, it is recommended that provision be made to construct three of the remaining six cribs needed to complete the north pier as now projected.

July 1, 1888, amount available.....	\$3,319.93
Amount appropriated by act of August 11, 1888.....	8,000.00
	<hr/> 11,319.93
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$612.26
July 1, 1889, outstanding liabilities.....	701.64
July 1, 1889, amount covered by existing contracts.....	8,081.58
	<hr/> 9,395.48
July 1, 1889, balance available	<hr/> 1,924.45
{ Amount (estimated) required for completion of existing project.....	20,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	25,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix K K 2.)	

3. *Harbor of refuge at Portage Lake, Michigan.*—The natural outlet from Portage Lake to Lake Michigan was not navigable, and the artificial channel was made at a point a mile further south, where the intervening beach was narrower.

The project authorized in 1879 was to make this a harbor of refuge with an entrance 300 feet in width and a depth of 18 feet.

To June 30, 1888, there has been expended \$81,719.07, but the insufficiency of the appropriation towards a work of such magnitude has left a great discrepancy between the results attained and those sought. The piers are but half built, the space between them has never been fully dredged, and from lapse of time and exposure the works are in a condition requiring partial rebuilding.

The draught of water is insufficient for even the moderate requirements of the locality, and a channel depth of 9 feet is only maintained by frequent and considerable dredging. During the past year \$2,240.88 was expended for this purpose, and contract has been made to spend \$5,000 more during this season, holding the balance remaining for further dredging and urgent repairs in the spring of 1890.

For the year ending June 30, 1891, it is considered that at least the north pier should be repaired and sand fences built at an expense of \$6,500, and that the fourth part of a dredging plant of tug, dredge, and two scows, amounting to \$6,500, with four months' work, costing \$4,200, should be provided for. These items, with 20 per cent. for contingencies, will make the total amount required for the fiscal year ending June 30, 1891, \$20,600.

The reconstruction of the south pier is also needful, but its proper location will depend upon whether the present project is adhered to or modified, in which case the south pier could advantageously be moved to a position parallel with and nearer to the north pier.

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July 1, 1888, amount available	\$780.93
Amount appropriated by act of August 11, 1888.....	10, 000. 00
	<hr/> 10, 780. 93
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$2, 036. 88
July 1, 1889, outstanding liabilities.....	204. 00
July 1, 1889, amount covered by existing contracts	4, 981. 47
	<hr/> 7, 222. 35
July 1, 1889, balance available.....	<hr/> 3, 558. 58
{ Amount (estimated) required for completion of existing project.....	97, 360. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	20, 600. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix K K 3.)	

4. *Harbor of Manistee, Michigan.*—Prior to the United States taking charge of the improvement a channel depth not exceeding 8 feet had been obtained by the construction of slab piers to confine the channel. The project of 1867, modified in 1870 and 1874, was designed to increase this depth to 12 feet.

The expenditures to June 30, 1888, aggregated \$230,786.51, and resulted in a channel with a nearly uniform depth of 14 feet and 15 feet between the piers, and an entrance width of 180 feet. Above the piers to the town of Manistee, about 1½ miles, the depth is reduced to 11½ to 12 feet.

The piers are in fair condition, but the pile-revetment prolonging them shoreward is in need of rebuilding above the water.

The expenditures for the past fiscal year were \$1,050.94, including \$500 as part payment for a survey steamer for the general service of the harbors in the East Lake Michigan district. Contract has been made for the construction of two additional cribs in the south pier which are well under way and will shortly be completed. With the remaining balance it is proposed to make repairs to the piers and dredge in the channel when needed.

For the year ending June 30, 1891, an appropriation of \$19,400 is recommended for repairing the north pile-revetment, for one-fourth the cost of a dredging plant, and to do two months of dredging in the river channel.

July 1, 1888, amount available.....	\$7, 213. 49
Amount appropriated by act of August 11, 1888.....	10, 000. 00
	<hr/> 17, 213. 49
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$795. 94
July 1, 1889, outstanding liabilities.....	255. 00
July 1, 1889, amount covered by existing contracts.....	9, 331. 00
	<hr/> 10, 381. 94
July 1, 1889, balance available.....	<hr/> 6, 831. 55
{ Amount (estimated) required for completion of existing project.....	72, 532. 50
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	19, 400. 00
{ Submitted in compliance with the requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix K K 4.)	

5. *Ludington Harbor, Michigan.*—The original entrance made by revetting with slabs the natural drain from the Pere Marquette Lake into Lake Michigan was narrow, with depth not exceeding 7 feet.

The 1867 project was to increase the depth to 12 feet and the width to 200 feet. A later project in January, 1885, proposed to convert the entrance into a "harbor of refuge," by widening it to 400 feet and deepening the channel to 18 feet. Under the original project the amount expended to June 30, 1888, was \$237,057.19.

The north pier projects 700 feet and the south pier 1,000 feet into the lake; the width between them is 200 feet and the channel depth about 13 feet, needing occasional dredging to maintain it. The piers are in fair condition, needing redecking, refilling, and minor repairs. The revetments on both sides need considerable repairs, and particularly measures to prevent the passage of sand through them into the channel.

During the past fiscal year the principal expenditure has been \$4,434.38, \$2,500 of which was for the part purchase of a survey steamer for general use in connection with the works on the east shore of Lake Michigan.

Under the project of 1885, above referred to, title to the strip of sand-beach adjacent to the present south pier has been vested in the United States preparatory to the construction of the new south pier 200 feet further south, but the details of the project have provisionally been modified, so as to begin the construction of the new south pier opposite to the terminus of the present one and connect them by a wing-pier. Contract has been made for the construction of ten new cribs on the north pier and seven on the south pier, the work to continue during the present and ensuing seasons. The balance on hand is sufficient to construct the then remaining six cribs on the south pier, completing them both, as well as providing for the needful expenditures, for which reason no additional appropriation for the fiscal year 1890-'91 is asked.

July 1, 1888, amount available	\$55,377.81
Amount appropriated by act of August 11, 1888.....	60,000.00
	<hr/>
	115,377.81
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$4,146.38
July 1, 1889, outstanding liabilities	288.00
July 1, 1889, amount covered by existing contracts.....	55,769.87
	<hr/>
	60,204.25
July 1, 1889, balance available	55,173.56
(See Appendix K K 5.)	

6. *Pentwater Harbor, Michigan.*—Prior to 1866 the outlet of Pentwater Lake into Lake Michigan had been improved at local expense by piers and revetments of slabs, the channel being about 75 feet in width and navigable to a depth of about 4 feet. The project of 1866 proposed to widen the entrance to 150 feet and a channel depth of 12 feet. The amount expended to June 30, 1888, was \$212,605.22, and as constructed the north pier projects 650 feet and the south pier 550 feet, with revetments 1,500 feet long on each side of the cut. The width between the piers is 150 feet and the depth ranges from 9 to 12 feet. The deficiency in the channel depth is owing to the constant accessions of sand from Lake Michigan into the mouth and through and over the piers and revetments, especially in the vicinity of the beach.

The south pier and the outer 400 feet of the north pier are in good condition, but the remainder of the north pier and all the revetments are decayed and open to the movement of sand and water.

The expenditures during the last fiscal year, \$1,524.66, were mainly for material for repairs.

Contract was made for dredging the channel 12 feet deep for a width of 48 feet, and the work is now in progress.

Contract was also made for the construction of a crib at the end of the south pier, which, on July 1, was built to the thirteenth course. Its construction will still leave four cribs, or 200 feet, to be added to the south pier to complete the project, but there is open water in front of the entrance, and the condition of the channel and protective works is so unsatisfactory that it is considered imperative to sheet-pile and otherwise protect them against sand drift and filtration. The cost of this, with part payment for and service of a dredging plant, will be \$20,800.

July 1, 1888, amount available.....	\$5,214.78
Amount appropriated by act of August 11, 1888.....	8,000.00
	<hr/> 13,214.78
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$1,368.66
July 1, 1889, outstanding liabilities.....	156.00
July 1, 1889, amount covered by existing contracts.....	9,192.09
	<hr/> 10,716.75
July 1, 1889, balance available.....	2,498.03
{ Amount (estimated) required for completion of existing project.....	37,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	21,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix K K 6.)	

7. *White River Harbor, Michigan.*—In its original condition White Lake discharged into Lake Michigan through a narrow and tortuous outlet three-fourths of a mile north of the present entrance. Prior to 1866 an attempt had been made by local interests to deepen the old outlet by the construction of slab-piers, and a depth of 5 feet was obtained. The project of 1866 called for the construction of a straight passage 200 feet wide with a channel depth of 12 feet, and located the new entrance to the southward, where the sand beach separating the two lakes was narrower and the water deep on both sides.

The expenditures to October 30, 1888, amounted to \$244,924.94. The north pier projects 450 feet in the lake with 1,050 feet of revetment on the banks of the cut, and the south pier 700 feet with 1,150 feet of revetment. The width between the piers is 200 feet, but owing to the absence of any useful current in the channel, and the constant accessions of sand from both lakes and from the shores through and over the permeable piers and revetments, constant dredging is required to keep it deep enough to serve the navigation interests. This spring, with the lake a foot below the normal level, but 7 feet could be carried in.

The outer 350 feet of the south pier needs partial decking and refilling, but is in good condition. The inner portion of the south pier, as well as the entire north pier and all the revetments, consist of pile-work, through which, and the loose filling, water and sand pass into the channel. Considerable portions of the exposed timber work also need repair and partial rebuilding. During the past fiscal year extensive repairs were made to about 700 feet of the north pier, which was also partially refilled with edgings ballasted with stone, and contract was made for the delivery of additional material for repairs to the south pier and the north revetment. Contract was also made to dredge the channel 5 to 12 feet for the relief of navigation. The work began in April and continued to June, making a channel 48 feet wide and 12 feet deep.

The expenditures for the year were \$4,473.68.

For the ensuing fiscal year measures should be taken to protect the channel from the intrusion of sand by sheet-piling and securing both piers and revetments with partial refilling, redecking, etc., which, with a sum sufficient for part payment for the services of a dredging plant, will cost about \$25,500.

To stop the encroachment of the shoal in the lake northward of the north pier, which is forcing its way across the entrance, two new cribs should be added, extending it 100 feet, but leaving it still three cribs, or 150 feet, short of its originally projected extension. The cost of the two cribs will be about \$11,000, and with 10 per cent. added for contingencies, etc., the total estimate for the year ending June 30, 1891, is \$42,000.

July 1, 1888, amount available	\$2,575.06
Amount appropriated by act of August 11, 1888.....	10,000.00
	<hr/> 12,575.06
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$4,291.68
July 1, 1889, outstanding liabilities	182.00
July 1, 1889, amount covered by existing contracts.....	3,826.46
	<hr/> 8,300.14
July 1, 1889, balance available	4,274.92
	<hr/>
{ Amount (estimated) required for completion of existing project.....	65,225.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	42,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix K K 7.)

8. *Muskegon Harbor, Michigan*—Prior to improvement by the United States, slab-piers and revetments had been built at the outlet of Muskegon Lake and River into Lake Michigan, with the result of securing 13 feet of water between them, but a bar with 7 feet on it existed in front of the entrance, which as constructed was only 175 feet in width. The project of 1866 took the work at this stage, and with subsequent modifications in 1869, 1873, 1881, and 1884 sought to provide a navigable channel of such depth as could be obtained by extending the piers to 17 feet in the lake, and to widen the entrance to 300 feet.

The amount expended to June 30, 1888, was \$232,635.82. The north pier projects into the lake 1,050 feet and has 1,450 feet of shore revetment. The south pier projects 800 feet with some 1,500 feet of revetment. The piers generally are in good condition, though the old portion of the south pier for about 350 feet from shore should be sheet-piled to make it tight. The shore revetments of slabs are in bad condition, and quite permeable to sand and water, and must be sheet-piled their entire length. The end of the north pier proper is about 190 feet from the south pier, but the outer detached 400 feet of north pier leaves an entrance width of 300 feet; 13½ feet can be carried through the channel.

During the past year the expenditures were \$3,909.98, principally for materials to be used in repairs, and including \$1,000 in part payment for a survey steamer for general use in the district.

Contract was made for 5 of the remaining 8 cribs to be built on the south pier, and these are in course of construction. Repairs are also to be made to both piers and revetments adjacent to the shore-line.

For the fiscal year ending June 30, 1891, the south pier should be completed by adding the remaining three cribs, costing \$18,000. The

3,000 feet of shore revetments should be sheet-piled and repaired to prevent injury to the channel by the passage of sand through them, at a cost of \$15,000. A dredging plant should be procured for the use of the adjacent works, and the Muskegon share of it, including two months' service, would be \$8,600. With allowance for contingencies, the amount required for 1891 is \$46,000.

July 1, 1888, amount available	\$1,364. 18
Amount appropriated by act of August 11, 1888.....	45,000. 00

46,364. 18

July 1, 1889, amount expended during fiscal year, exclusive of	
liabilities outstanding July 1, 1888.....	\$3,789. 98
July 1, 1889, outstanding liabilities	120. 00
July 1, 1889, amount covered by existing contracts	26,615. 99

30,525. 97

July 1, 1889, balance available.....	15,838. 21
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{ Amount (estimated) required for completion of existing project	47,075. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	46,000. 00
{ Submitted in compliance with requirements of sections 2 of river and	
harbor acts of 1866 and 1867.	

(See Appendix K K 8.)

9. *Grand Haven Harbor, Michigan.*—Grand River is a stream of considerable volume, and in its natural condition maintained a variable entrance channel of 8 or 9 feet. Prior to 1866, when the United States took charge of the work, a pier and shore revetment had been built on the south side, for the benefit of the lumber interests and the Detroit and Milwaukee Railroad, which had its terminus inside the mouth, opposite Grand Haven. The project of 1866 proposed to secure 18 feet of water, with an entrance width of 400 feet, at an estimated cost of \$350,000. As the work advanced it was found that entrance depths of 13 and 14 feet were obtained, but that the shoal outside the pier, consisting of material accumulated at the mouth of the river by the action of the stream and the lake storms and currents often obstructed the mouth so as to hinder navigation. In 1880 the project was enlarged to provide for greater pier extension and shore revetment, at an additional cost of about \$300,000, making the total cost of the project about \$650,000, subject to needed repairs during time consumed in construction. To June 30, 1888, \$513,458.98 had been expended.

The north pier projects 1,000 feet and the south pier 1,350 feet into the lake, with 1,850 feet of shore revetment on the north side, and 3,950 feet of shore and channel revetment on the south side. The entrance is 400 feet in width, and 14½ and 15 feet can be carried in over the outer bar with depths of 3 to 4 fathoms between the piers and protected portions of the river. The north pier lacks 750 feet of its proposed extension, and 1,500 feet of shore revetment, and the south pier 550 feet of projection.

The works are in good condition generally, although the south revetment needs considerable repairs and partial rebuilding, and the north revetment should be extended about 1,500 feet to complete the shore protection on that side. During the year ending June 30, 1889, contract was made for an extension of the north pier by three cribs, equal to 150 feet, on pile foundation, and repairs have been made to the south revetment. These works are still in progress.

The expenditures to June 30, 1889, amount to \$7,778.85, including \$1,000 part payment for a survey steamer for general service in the district. The current balance of \$1,500, after paying for repairs, etc.,

in progress, will be in part used to construct sand-fences on the north and south beaches, and the remainder held to meet requirements next spring.

For the fiscal year 1890-'91 \$75,000 will be required to provide for the construction of ten new cribs, extension of north revetment, part purchase and use of dredging plant, and minor items. The ten cribs would be placed, four on the south pier and six on the north, representing about one fair season's work under one contract, and their construction would still leave thirteen cribs to be built, six on the north and seven on the south pier. Attention is invited to the favorable conditions existing at Grand Haven for the formation of a capacious and safe harbor for both local and general uses, and to the beneficial results that have been thus far attained by the partial completion of the project.

July 1, 1888, amount available	\$10,907. 17
Amount appropriated by act of August 11, 1888	25,000. 00
	<hr/>
	35,907. 17
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$7,396. 85
July 1, 1889, outstanding liabilities	382. 00
July 1, 1889, amount covered by existing contracts	19,647. 04
	<hr/>
	27,425. 89
	<hr/>
July 1, 1889, balance available	8,481. 28
	<hr/>
{ Amount (estimated) required for completion of existing project	103,404. 32
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	75,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix K K 9.)

10. Black Lake Harbor, Michigan.—Prior to 1866 the citizens of Holland, situated on Black Lake, desiring access to and from Lake Michigan, opened an artificial outlet and revetted it with brush and crib constructions, but the 5½-foot bar in front proved a formidable obstacle. Under the Government project of 1866 the old piers were extended to 600 feet and 780 feet into the lake, and now terminate in 12 or 15 feet of water with still better depths immediately beyond them. Between the piers, however, the channel has always been more or less obstructed with sand blown or driven in by wind and waves, and the inadequacy of the revetments to prevent the passage of sand through them has constantly counteracted the service of the dredge. There is no current in the channel, or rather the movement is as often in one direction as the other.

The piers are 200 feet apart, and the greater part of the entrance has 10 and 12 feet of water, the obstructions lying between the shore lines and the end of the piers.

The cost of the work to June 6, 1888, was \$257,091.50.

During the past fiscal year repairs were made nearly to the limit of the funds then on hand, \$7,052.34, but to secure a navigable depth the inner portions of the piers and the entire length of shore revetment must be sheet-piled and otherwise made sand-tight, so that future dredging may be of some effect. If navigation is to be kept open the measures indicated are necessary, and the provisional estimate for the fiscal year 1891, including sand-fences, sheet-piling, and minor repairs, stone filling, etc., and the part purchase and three months' use of dredging plant, with allowance for contingencies and superintendence, amounts to \$23,500.

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July 1, 1888, amount available.....	\$2, 523. 81
Amount appropriated by act of August 11, 1888.....	5, 000. 00
	<hr/> 7, 523. 81
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	7, 052. 34
July 1, 1889, balance available.....	<hr/> 471. 47
<hr/>	
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	
{ Submitted in compliance with requirements of sections 2 of river and	
{ harbor acts of 1866 and 1867.	
(See Appendix K K 10.)	

11. *Saugatuck Harbor, Michigan.*—The original slab-piers at the mouth of the Kalamazoo River were built by subscription, and the available depth was 7 feet.

The entrance was examined in 1867, and the project for its improvement provided for the repair and strengthening of the old piers and the construction of channel-revetments on both banks, especially the south or concave side of the stream, with the intention, if practicable, of deepening the draught to 10 feet. It was found, however, some years since, that the appropriations for the work were insufficient to contend against the unusual natural difficulties of the situation, and construction work was practically suspended in 1876, since when, with the exception of a portion of the north revetment, the expenditures have been for repairs and dredging.

The total expenditures to June 30, 1888, were \$134,455.63, and for the past fiscal year, \$543.25.

At the present time 8½ feet can be carried over the bar; and 8 feet to Saugatuck, ¾ miles up the river. The piers project 200 feet into the lake, and the south revetment has a length of 3,650 feet, reaching around the lower bend of the river. The works are on piles, and the filling has generally sunk into the bottom, permitting the flow of water through them, in addition to which the upper portions are rotting with age and exposure.

The river has considerable natural capacity, and if thoroughly protected against the accumulation of sand that reaches it from the broad naked expanse lying between it and the lake could, by the extension of the piers and the construction of sand-tight revetments and other sand defenses, be made to carry a 10 or 12 foot navigation.

July 1, 1888, amount available.....	\$983. 37
Amount appropriated by act of August 11, 1888.....	5, 000. 00
	<hr/> 5, 983. 37
July 1, 1889, amount expended during fiscal year exclusive of liabilities outstanding July 1, 1888.....	\$543. 25
July 1, 1889, amount covered by existing contracts.....	1, 871. 70
	<hr/> 2, 414. 95
July 1, 1889, balance available.....	<hr/> 3, 568. 42
(See Appendix K K 11.)	

12. *South Haven Harbor, Michigan.*—Prior to improvement by the United States, the citizens of South Haven had sought to protect the mouth of Black River by the construction of piers and revetments, and the entrance was made with a width of 85 feet and a depth of 7 feet, with 9 or 10 feet on the bar outside. The project of 1866, as modified and extended in 1869 and 1872, provided for an entrance width of 180 feet and a navigable depth of 12 feet.

To June 30, 1888, the total expended was \$181,980.05.

The piers projected respectively 800 feet and 900 feet into the lake, with 800 and 950 feet of channel-revetment. The bar outside had 12 to 12½ feet of water, but between the piers, and particularly in the vicinity of the shore-line, as in numerous similar cases, the navigable depth was reduced for a distance of about 300 feet to 8 and 10 feet by the accumulation of sand moved by winds and waves. The works in general are in fairly good condition, but the inner piers and revetments of slabs and piles permitted sand to flow over and through them, and the inner end of the north revetment for about 400 feet needed rebuilding. The outer crib of the north pier also had been seriously damaged and cut down by ice and collisions. The expenditures for the past fiscal year, \$1,167.22, were mainly for dredging. Six thousand cubic yards were taken out in May, 1889, opening the channel to 12 feet for a width of 24 feet. Further dredging had to be deferred to meet equally urgent demands from the other harbors.

To maintain the channel depth of 10 and 12 feet, of which the harbor is easily capable, the inflow of sand must be checked to reduce the amount of dredging annually required. For this purpose it is estimated that \$21,500 will be needed to sheet-pile the inner piers and revetments, construct sand-fences, and partly purchase and use a suitable dredging plant for the service of this and the immediately adjacent harbors. Until these provisions shall have been made, the question of pier extension should be deferred.

July 1, 1888, amount available.....	\$19.95
Amount appropriated by act of August 11, 1888.....	10,000.00
	<hr/> 10,019.95
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$1,167.22
July 1, 1889, amount covered by existing contracts.....	5,837.08
	<hr/> 7,004.30
July 1, 1889, balance available	<hr/> 3,015.65
{ Amount (estimated) required for completion of existing project.....	21,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	21,500.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix K K 12.)	

13. *St. Joseph Harbor, Michigan.*—The original condition of the entrance can not now be ascertained from the records. The outflow of the combined St. Joseph and Paw Paw rivers discharged into Lake Michigan across a broad stretch of sand beach, with correspondingly shallow and variable channel widths and depths. The improvement was begun by the United States in 1836 by confining the flow to a width of 240 feet between piers projecting into the lake. In 1863 the official sketch shows a depth of 12 feet, reducing to 9 feet in the Upper Basin.

The present project, as approved in 1866 and modified in 1874 and 1875, is to increase the entrance depth, if practicable, to 16 feet, and carry 13 feet to Benton Harbor by means of a straight cut 100 feet wide, with revetted banks, and a wing-dam at the lower end.

The amount expended from 1836 to June 30, 1888, was \$341,607.90. The bar outside the entrance had 15 feet upon it; between the piers the depth varied from 22 feet to 18 feet, and near the Chicago and West Michigan Railroad Bridge, 12 feet. The lower portion of the Benton Harbor Canal is but 80 feet wide, and should be widened to 100 feet. The depth in the canal was 10 and 11 feet.

The amount expended during the year ended June 30, 1889, was \$6,298.44.

The south pier was decked and repaired, the Benton Harbor Canal dredged to 13 feet deep with a width of 25 to 28 feet, and the 13-foot channel continued to deep water between the piers with a width of 75 feet.

A pile wing-dam to connect the inner end of the north pier with the shore for the protection of the pier and the Life-Saving Station, was nearly completed at the close of the year.

For the year ending June 30, 1891, it is estimated that \$35,000 will be required to widen, revet, and deepen the Benton Harbor Canal, dredge the lower channel, repair the piers, and in part purchase a dredging plant for the use of contiguous harbors.

July 1, 1888, amount available	\$505. 10
Amount appropriated by act of August 11, 1888.....	12, 000. 00
	<hr/> 12, 505. 10

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$5, 517. 44
July 1, 1889, outstanding liabilities.....	781. 00
July 1, 1889, amount covered by existing contracts.....	2, 895. 22
	<hr/> 9, 193. 66

July 1, 1889, balance available	3, 311. 44
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{ Amount that can be profitably expended in fiscal year ending June 30, 1891	35, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix K K 13.)

14. *St. Joseph River, Michigan.*—The act of August 11, 1888, appropriated \$2,500 for the improvement of the river between its mouth and Berrien Springs.

In its natural condition the river is obstructed by sand and gravel-bars, drift-logs, etc., affording a depth of about 2 feet at low stages.

It is proposed during the present season to deepen this to 3 feet at the obstructed points by the removal of bars and the construction of low dams of brush and stone.

If the work is to be continued, an appropriation of \$1,000 should be made for the year ending June 30, 1891.

Amount appropriated by act of August 11, 1888	\$2, 500. 00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$16. 48
July 1, 1889, amount covered by existing contracts.....	250. 00
	<hr/> 266. 48

July 1, 1889, balance available	2, 233. 52
---------------------------------------	------------

{ Amount that can be profitably expended in fiscal year ending June 30, 1891	1, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix K K 14.)

15. *Michigan City Harbor, Indiana—Outer Harbor.*—This work was projected in 1870 and begun in 1872, for the purpose of constructing a harbor of refuge, exterior to the "Inner Harbor" made by the revetment and pier protection of the entrance to Trail Creek, which constitutes the Michigan City Harbor proper. The works proposed were the extension of the then existing west pier, the construction of a new east pier 1,400 feet eastward, with a length of 1,100 feet into the lake, and a breakwater 1,400 feet in length, connecting with the east pier and leaving an en-

trance of 210 feet between the west end of the breakwater and the outer end of the west pier extended. These works were completed in 1884, together with 250 feet of an additional work found needful to protect the entrance from the powerful currents past the mouth. This work projects into the lake at right angles to the breakwater, and in 1885 100 feet additional length was given it.

In 1882 it was found that the then existing works did not afford that due security of entrance and anchorage that were needed for a harbor of refuge, and an outer breakwater was projected with a length of 2,000 feet beginning at a point 400 feet west of the outer end of the breakwater pier and calculated to furnish an anchorage area of about 30 acres.

To June 30, 1888, the expenditures for the "Outer Harbor" aggregated about \$558,471.17, the exact amount depending upon a full examination of the accounts, due to the fact that for several years, while the work was in progress, the appropriation acts failed to distinguish between the "Inner" and "Outer" harbors, although the first appropriation for the "Outer Harbor," viz, that of June 30, 1872, was specifically for that work.

During the past year the expenditures amounted to \$18,054.51 to pay for two new cribs placed in the Breakwater Pier and for redecking the west pier, which is now in good condition. The breakwater constituting the north face of the Outer Basin, the early portions of which were built in 1875, is now in a condition calling for early and extensive repairs. The east pier, built of piles, is quite open to the movement of the water, and large quantities of sand are carried into the "basin." It should be made tight by substantial sheet piling on the outer side, refilled, repaired, and redecked. This it is proposed to do during the current fiscal year.

Contract was made in March, 1889, for the construction of thirteen 50-feet by 30-feet cribs on stone foundation, three to complete the "Breakwater Pier" and the remaining ten to begin the construction of the "Outer Breakwater." At the close of the year the three cribs had been placed and four were under way.

For the year 1891 \$75,000 is estimated for the construction of ten new cribs for the "Outer Breakwater," \$10,000 for a tug for the service of the harbor, which already has a dredge and scows, and \$1,000 for dredging near the outer entrance. The total, with allowance for contingencies, etc., is \$95,000.

July 1, 1888, amount available.....	\$20,903.83
Amount appropriated by act of August 11, 1888	90,000.00

110,903.83

July 1, 1889, amount expended during fiscal year, exclusive of	
liabilities outstanding July 1, 1888.....	\$17,802.41
July 1, 1889, outstanding liabilities.....	252.00
July 1, 1889, amount covered by existing contracts.....	57,352.41

75,406.82

July 1, 1889, balance available.....	35,497.01
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{ Amount (estimated) required for completion of existing project.....	329,613.50
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	95,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix K K 15.)

Inner harbor.—The construction of the harbor was begun in 1836 and continued, partly at the cost of the United States and partly of Michi-

gan City, by the dredging and revetting of the creek and the building of piers for the protection of the entrance from the lake.

The expenditures prior to 1866 for the purposes indicated amounted to \$156,203.92. At this date Congress appropriated \$75,000 on condition that it should be shown that the local authorities had themselves expended \$100,000, and this having been shown to be the case, the engineer in charge proposed a project to extend the piers in order to open a channel through an outer bar lying across the entrance. This project was later extended, both to include an additional length of piers and a considerable extension landward of the portions of the creek to be dredged and improved. At the present time the dredge maintains a channel through those portions of the creek which are used for business purposes.

To June 30, 1888, the expenditure amounted to \$93,896.43, and for the past fiscal year \$5,305.73, which was expended in taking out 64,085 cubic yards of material from the channel, making depths varying from 15 feet in the lower part to 12 feet in the upper.

To continue dredging work during the fiscal year 1891, there will be needed for dredging, \$5,000; for a new dump-scow, \$2,500, and for contingencies \$1,500; making a total estimate of \$9,000.

July 1, 1888, amount available	\$2,978.57
Amount appropriated by act of August 11, 1888.	5,000.00
	<hr/> 7,978.57
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$4,890.73
July 1, 1889, outstanding liabilities.....	415.00
	<hr/> 5,305.73
July 1, 1889, balance available.....	2,672.84
	<hr/> 9,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix K K 15.)	

EXAMINATIONS AND SURVEY FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examinations of the following localities were made by the local engineer in charge, Lieutenant-Colonel Mansfield, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers concurring in the conclusions reached in these instances, has given no instructions to make further survey with the view to their improvement.

1. *Saugatuck Harbor, Michigan, to obtain channel of navigable width, with a minimum depth of 15 feet and reconstructing piers.*—(See Appendix K K 16.)

2. *Grand River, Michigan, from Grand Rapids to Lake Michigan; for channel of navigable width, minimum depth of 10 feet.*—(See Appendix K K 17.)

It appearing from the report of the preliminary examination made by the local engineer of *Petoskey Harbor, Michigan, for breakwater and harbor of refuge*, that the locality is worthy of improvement, and the public necessity therefor being apparent from the facts and reasons reported, which are concurred in by the Chief of Engineers, Major Ludlow was charged with its survey, the results of which will be submitted when received.

IMPROVEMENT OF ST. MARY'S RIVER—ENLARGEMENT OF AND OPERATING ST. MARY'S FALLS CANAL—CONSTRUCTION OF HARBOR OF REFUGE ON LAKE HURON, AND IMPROVEMENT OF CERTAIN HARBOES ON LAKE HURON AND OF SAGINAW RIVER—PRESERVATION OF AND OPERATING ST. CLAIR FLATS CANAL—IMPROVEMENT OF GROSSE POINT CHANNEL AND OF DETROIT, CLINTON, ROUGE, AND BLACK RIVERS.

Officer in charge, Col. O. M. Poe, Corps of Engineers, with Lieut. H. F. Hodges, Corps of Engineers, under his immediate orders until August 26, 1888; Lieut. W. E. Craighill, Corps of Engineers, under his immediate orders from January 12 to March 29, 1889, and with Lieut. C. S. Riché, Corps of Engineers, under his immediate orders since April 10, 1889.

1. *St. Mary's Falls Canal and River, Michigan.*—The project for obtaining a navigable channel of 16 feet depth between Lakes Superior and Huron had been barely completed when the demands of commerce so enormously increased that the work of obtaining a depth of 20 feet throughout was undertaken, with the full sanction of both legislative and executive authority.

A necessary part of the project is the construction of a new lock upon the site of the old State locks, to have a length of 800 feet between gates, a width of 100 feet throughout, a depth of 21 feet on the miter-sills, and a single lift approximating 18 feet. The canal is to be deepened to correspond. The estimated cost of this enlargement of the canal system is \$4,738,865, for the details of which see pages 2220 *et seq.* of the Annual Report of the Chief of Engineers for 1887. One million dollars has already been appropriated, and contracts have been entered into for the excavation of the lock-pit, and the construction of a pier in front of Fort Brady. The statistics of the commerce using the canal indicate more clearly each succeeding year the urgency for rapid progress in the improvement. It is now so great that an estimate of \$1,236,000 is submitted for the prosecution of the work during the fiscal year ending June 30, 1891, in full confidence that the actual conditions now existing will justify so large an appropriation.

The aggregate expended on this work to June 30, 1888, was	\$134,625.93
The amount expended during the fiscal year ending June 30, 1889, was	115,705.59
Total expenditures to June 30, 1889	250,331.52
July 1, 1888, amount available (but covered by existing contracts)	90,968.22
Amount appropriated by act of August 11, 1888	1,000,000.00
	<hr/> 1,090,968.22
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$69,307.67
July 1, 1889, outstanding liabilities	21,965.44
July 1, 1889, amount covered by existing contracts	254,753.25
	<hr/> 346,026.36
July 1, 1889, balance available	744,941.86
{ Amount (estimated) required for completion of existing project	3,738,865.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	1,236,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix L L 1.)	

2. *Operating and care of St. Mary's Falls Canal, Michigan.*—During the fiscal year the canal was open to navigation two hundred and thirty-two days. It was closed for the winter December 2, 1888, and opened April 15 for the season of 1889.

Eight thousand eight hundred and thirty-two vessels, etc., representing a registered tonnage of 6,213,494 tons, and carrying 6,932,203 tons of freight and 26,428 passengers, passed through in 4,390 lockages.

The staple articles transported were 1,854,527 tons of coal, 30,261 tons of copper, 2,157,973 barrels of flour, 15,202,021 bushels of grain, 3,414,859 tons of iron ore, 59,052 tons of pig and manufactured iron, 206,957 barrels of salt, 3,480 tons of silver ore, 276,181,000 feet, B. M., of lumber, 33,772 tons of building stone, 2,014 tons of wool, 310 tons of hides and 349,345 tons of unclassified freight.

The expenditures on account of operating and care for the fiscal year aggregated \$30,749.45 and the receipts for dry-docking were \$124.

The estimated amount required for the fiscal year ending June 30, 1890, is \$43,200, all of which is already provided for by indefinite appropriation.

(See Appendix L L 2.)

3. *Dry-dock at St. Mary's Falls Canal, Michigan.*—Owing to the progress made in the excavation for the new lock at St. Mary's Falls Canal, all propositions looking towards the conversion of the old State locks into a dry-dock are finally disposed of and need not again be referred to.

The proposition to locate a dry-dock in immediate proximity to the lockage system is as objectionable as ever; but if it should be decided to be so, then the location heretofore referred to, at the eastern end of the area transferred from the Fort Brady military reservation to the canal reservation, is the least objectionable.

But the construction of a pier in front of the Fort Brady reservation has now advanced beyond the point where a dry-dock should be located, and a portion of this work would have to be removed, thus increasing by \$20,000 the probable cost of a dry-dock, and the estimate therefor should be increased accordingly.

Amount (estimated) required for the construction of a dry-dock at the point indicated, \$343,872.

It is understood the State of Michigan holds \$65,000 in readiness to transfer to the United States for the purpose of constructing a dry-dock at St. Mary's Falls Canal.

(See Appendix L L 3.)

4. *Hay Lake Channel, St. Mary's River, Michigan.*—The original estimates for this improvement were based upon a project for a channel 300 feet wide and 17 feet deep, leaving the present navigable channel of St. Mary's River at Sugar Island Rapids (about $2\frac{1}{2}$ miles below the canal), through these into Hay Lake, and then, by way of the Middle Neebish, rejoining the present navigable channel at the foot of Sugar Island, thus saving a distance of 11 miles and obtaining a route which can be so marked by lights as to be navigable at night, a condition impracticable with the present channel, except by the use of many lights.

The estimated cost of this project was \$2,127,292. The project was subsequently modified to increase the depth to 20 feet, the estimated cost being \$2,659,115, subject to change, however, in case unexpected difficulties are developed during the progress of the work.

The amount thus far appropriated for the work is \$975,000, all of which has either been expended or is covered by existing contracts, except

\$200,000, which is reserved under the proviso of that item of the river and harbor act of August 11, 1888, by which the appropriation is made for this improvement.

The work is progressing well, and with ample appropriations could be pushed with great energy. The length of the route is sufficient to admit of the use of a very extensive plant. An estimate of \$500,000 is sufficient, one-half to be applied at Middle Neebish and the other half at Sugar Island Rapids, where right of way has now been obtained.

The aggregate expended on this improvement to June 30, 1888, was.... \$394,596.44
The amount expended during the fiscal year ending June 30, 1889, was. 103,172.04

Total expenditure to June 30, 1889..... 497,768.48

July 1, 1888, amount available (but covered by existing contracts) 73,593.44

Amount appropriated by act of August 11, 1888..... 500,000.00

573,593.44

July 1, 1889, amount expended during the fiscal year, exclu-

sive of liabilities outstanding July 1, 1888 \$94,219.01

July 1, 1889, outstanding liabilities..... 2,011.26

July 1, 1889, amount covered by existing contracts..... 287,361.68

383,591.95

July 1, 1889, balance available..... 190,001.49

{ Amount (estimated) required for completion of existing project..... 1,684,115.00

{ Amount that can be profitably expended in fiscal year ending June 30, 1891 500,000.00

{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix L L 4.)

5. *Harbor at Oheboygan, Michigan.*—Prior to undertaking any improvement at this harbor only 6½ to 7 feet of water could be carried across the bar at the mouth of Oheboygan River.

The original project for the improvement, adopted in 1871, contemplated dredging a channel 200 feet wide and 14 feet deep through the bar, and revetting each side by a pile-pier. Experience gained during the progress of the work already done leads to the belief that the piers can be dispensed with, with consequent reduction of cost to the extent of about one-half the original estimate.

Subsequent modifications of the project were made until, as it now stands, it provides for a channel of 15 feet in depth, and generally 200 feet in width from the 15-foot curve in the Straits of Mackinac to the State Road Bridge.

Five thousand two hundred and sixty-four dollars and seven cents have been expended upon the work during the fiscal year, and only about 16,500 cubic yards remain to be excavated to complete the projected channel. It is expected that this will be completed before December 1, 1889, leaving the appropriation of August 11, 1888, untouched.

Until the dredged channel begins to silt up, or the revetting piers contemplated in the original project of 1871 are shown to be necessary, no further work is proposed, and therefore no further estimate is submitted at this time.

The aggregate expended on this harbor to June 30, 1888, was..... \$118,718.64
The amount expended during the fiscal year ending June 30, 1889, was.. 5,264.07

Total expenditures to June 30, 1889..... 123,982.71

July 1, 1888, amount available (but covered by existing contracts)	\$14, 315. 12
Amount appropriated by act August 11, 1888.....	15, 000. 00
	<hr/> 29, 315. 12
July 1, 1889, amount expended during the fiscal year, exclusive of liabilities outstanding July 1, 1888	\$4, 622. 40
July 1, 18 9, outstanding liabilities.....	641. 67
July 1, 1889, amount covered by existing contract.....	9, 051. 05
	<hr/> 14, 315. 12
July 1, 1889, balance available.....	15, 000. 00
(See Appendix L L 5).	

6. *Harbor at Thunder Bay, Michigan.*—Prior to the commencement of the improvement there was a navigable channel from the bay into the river of 12 feet depth, and a variable width, at one place only 50 feet. The original project for the improvement of this harbor was adopted in 1876, the object being to obtain an entrance channel from the bay into the river of navigable width, and of not less than 13 feet in depth. The project was subsequently modified to such an extent as to provide for a depth of 14 feet.

This had been practically accomplished at the date of the annual report for 1884. It was then stated that the improvement was of such a character that it would require attention from time to time, and it was recommended that sufficient appropriation be made to render available the sum of \$10,000 for use when it should be wanted. This was not done and the matter remained in abeyance.

Complaints of insufficiency of water arise from three causes:

- (1) Deterioration of depth (due to deposit).
- (2) A low stage of water in Lake Huron.
- (3) The general use of larger vessels.

This was the condition of the improvement up to June 30, 1888, up to which time \$15,002.22 had been expended on the work, and \$4,510.91 remained available. The river and harbor act of August 11, 1888, required the expenditure of this balance for dredging, and a contract has been let, and 5,290 cubic yards excavated up to the close of the fiscal year.

The commerce of the harbor last season, as reported by the inspector of dredging, amounted to a value of \$5,529,651. A demand for a 16-foot navigation has arisen in consequence, and is well worthy of consideration.

To fully restore the 14-foot channel will require an additional appropriation of \$5,500. To increase the channel depth to 16 feet will require an additional appropriation of \$30,000. The harbor is well worthy of the latter improvement.

The aggregate expended on this harbor to June 30, 1888, was	\$14, 434. 38
The amount expended during the fiscal year ending June 30, 1889, was....	2, 232. 72
Total expenditure to June 30, 1889.....	<hr/> 16, 667. 10
July 1, 1888, amount available.....	4, 510. 91
May 31, 1889, repayment of disallowance of part of voucher 1, June, 1888 .	3. 20
	<hr/> 4, 514. 11
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$40. 72
July 1, 1889, outstanding liabilities.....	2, 192. 00
July 1, 1889, amount covered by existing contracts.....	2, 281. 39
	<hr/> 4, 514. 11

{ Amount that can be profitably expended in fiscal year ending June 30, 1891 30, 000 00
 { Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix L L 6.)

7. *Harbor of Au Sable, Michigan.*—The present project for the improvement of this harbor was adopted in 1866, and modified in 1879, the object being to obtain a channel of not less than 10 feet in depth for a width of 100 feet, from Lake Huron to the State Road Bridge at Au Sable.

The works constructed in former years are in much the same condition as reported last year, (page 1962, Report of the Chief of Engineers, 1888).

By the river and harbor act of August 11, 1888, it was directed that the "balance available from former appropriations shall be expended in dredging at the mouth of Au Sable River."

The balance available is \$4,848.97, and to carry into effect this provision, it was decided to dredge a channel having a minimum width of 60 feet (two dredge cuts) and depth of 10 feet, across the bar at the mouth of Au Sable River, a distance of about 1,200 feet, and to remove some minor shoals in the river-channel above the bar. This being done, to then apply any balance that may remain to widening the channel across the bar, the object being to secure a navigable depth of 10 feet, for such width as the available funds will suffice to pay for.

By advertisement dated May 21, 1889, proposals for the requisite dredging were invited June 10, and then opened. The contract was awarded the only bidders, Messrs. Carlin, Stickney & Cram, at 34½ cents per cubic yard, scow measurement; the work to begin when they shall have completed their present contract at the harbor of Thunder Bay.

This harbor is not susceptible of permanent improvement at a cost commensurate with the necessities of the case. Therefore no estimate for continuing the improvement is submitted.

The aggregate expended on this harbor to June 30, 1888, was	\$109, 133. 65
The amount expended during the fiscal year ending June 30, 1889, was..	26. 94
Total expenditure to June 30, 1889.....	109, 160. 59
July 1, 1888, amount available	4, 845. 77
May 31, 1889, repayment of disallowance of part of voucher 1, June, 1888.	3. 20
	4, 848. 97
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$26. 94
July 1, 1889, amount covered by existing contracts.....	4, 822. 03
	4, 848. 97

(See Appendix L L 7.)

8. *Saginaw River, Michigan.*—The present project aims to secure a channel 200 feet wide, 14 feet deep, from Saginaw Bay to Bay City, and 12 feet deep, thence to the head of navigation in Saginaw River, a total distance of about 23 miles.

By the river and harbor act of August 5, 1886, the improvement of the west channel along West Bay City was added to the original project.

Contracts have been made for the expenditure of \$65,000, appropriated for the improvement of the river by the act of August 11, 1888, and operations have been in progress since the opening of the season with every prospect that the funds available will be practically exhausted, and the work covered by the contracts completed before its close.

The progress made during the fiscal year to June 30, 1889, was as follows:

Bar at mouth of river.—Cut No. 4 east of the axis of the channel was extended 2,170 feet with width of 30 feet and depth of 14 feet. The

quantity of material removed was 13,468 cubic yards, scow measurement, at the contract price of 49 cents per cubic yard.

West channel along West Bay City.—The quantity of material removed was 10,511 cubic yards, scow measurement, at the contract price of 23 cents per cubic yard.

Above Bay City.—Owing to delay upon the part of the saw-mill from which the contractors have engaged their lumber, the progress upon the extension of the Carrollton revetment has not been as rapid as desirable, though it is expected that the work covered by the contract will be easily completed within the specified time.

The estimate herewith submitted covers only so much of the present approved projects as can be advantageously completed during the fiscal year ending June 30, 1891, and amounts to \$139,000, distributed as follows, viz:

Above Bay City	\$29,000. 00
Bar at mouth of river	100,000. 00
West Channel along West Bay City	10,000. 00
Total	139,000. 00

The aggregate expended on this improvement to June 30, 1888, was	427,201. 34
The amount expended during the fiscal year ending June 30, 1889, was...	12,394. 68

Total expenditure to June 30, 1889	439,596. 02
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July 1, 1888, amount available	1,074. 13
Amount appropriated by act of August 11, 1888	65,000. 00
	66,074. 13

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$2,752. 50
July 1, 1889, outstanding liabilities	9,642. 18
July 1, 1889, amount covered by existing contracts	53,679. 45
	66,074. 13

{ Amount (estimated) required for completion of existing project	237,250. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	139,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L L 8.)

9. Harbor of refuge at Sand Beach, Lake Huron, Michigan.—The present project for this improvement was adopted in 1873. It consists of a break-water constructed of timber cribs filled with stone inclosing an area which is to be deepened by dredging where necessary.

Its object is to afford a harbor of refuge to vessels when caught in heavy weather near the dangerous Pointe aux Barques, the southerly headland of the mouth of Saginaw Bay. Prior to 1876 vessels so caught were compelled to run a distance of 60 miles and find refuge in St. Clair River. After the subsidence of the storm those upward bound had to work their way back again. Few improvements have resulted in greater benefit to the lake commerce, as is fully shown by the infrequency of disasters in the vicinity since it became available.

The estimate of the probable cost of the improvement was \$1,442,500. The sum of \$1,125,000 has been appropriated for the work, and it has been practically completed at a cost of about \$975,000.

If sufficient in amount, the next appropriation should be expended in beginning the construction of a permanent superstructure for current repairs, for custody and control of the harbor, and for dredging in and about the harbor.

The aggregate expended on this harbor to June 30, 1888, was.....	\$1,034,420.98
The amount expended during the fiscal year ending June 30, 1889, was.....	21,165.96
Total expenditures to June 30, 1889.....	1,055,586.94
July 1, 1888, amount available, but covered by existing contracts.....	11,411.94
Amount appropriated by act of August 11, 1888.....	70,000.00
	81,411.94
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$12,899.35
July 1, 1889, outstanding liabilities.....	3,869.30
July 1, 1889, amount covered by existing contracts.....	7,158.42
	23,927.07
July 1, 1889, balance available	57,484.87
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	150,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L L 9.)

10. *Mouth of Black River, Michigan.*—The present project, approved March 6, 1889, contemplates making a series of dredge cuts, of a uniform depth of 16 feet, along the dock front of Port Huron, from the 16-foot curve above, to the same curve below the mouth of Black River, the first cut at a distance of about 50 feet from the wharves, and the others to continue the work outward as far as the funds will permit.

Black River empties into St. Clair River at Port Huron, Mich. At and below its mouth, extending beyond the middle of St. Clair River, there is a bar or middle ground which was dredged by the Government, under former appropriations, to a clear depth of 15 feet. The main channel of St. Clair River is found between the middle ground and the Canadian shore.

By the deposit of material brought down by the current of Black River, the depth on this bar has been reduced an average of about 6 inches, and, in conjunction with a low stage of water, had become an impediment to navigation along the front of the city in the vicinity of the mouth of Black River.

By the river and harbor act of August 11, 1888, the sum of \$10,000 was appropriated for "improving mouth of Black River, Michigan." A project for its expenditure was submitted March 2, 1889, which received prompt approval and now constitutes the approved project.

Under date of March 19, 1889, proposals were invited by public advertisement for dredging in accordance with the project. The bids received were opened April 18, 1889, and the contract duly awarded to William Richardson, the lowest bidder, at 20 cents per cubic yard measured in the scows.

The dredging began on May 17, and has been continuously prosecuted since that time. At the close of the fiscal year 20,800 cubic yards had been removed, and a channel 16 feet deep and of sufficient width for careful navigation had been opened across the obstruction.

The expenditure of the appropriation will afford very marked relief, and it should be continued until a uniform depth of 16 feet is obtained over the whole extent of the bar.

The sum of \$20,000 can be expended to advantage during the fiscal year ending June 30, 1891.

The aggregate expended on this project to June 30, 1889, is \$4,413.02.

Amount appropriated by act of August 11, 1888	\$10, 000. 00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$1, 322. 22
July 1, 1889, outstanding liabilities	3, 090. 80
July 1, 1889, amount covered by existing contracts	5, 586. 98
	<u>10, 000. 00</u>

{ Amount that can be profitably expended in fiscal year ending June 30, 1891 20, 000. 00
 { Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1887.

(See Appendix L L 10.)

11. *St. Clair Flats Canal, Michigan.*—This canal was projected in 1866, with a view to obtaining a straight channel 13 feet deep and 300 feet wide, across St. Clair Flats, the channel being bounded on each side by a dike 7,221 feet long, or an aggregate of 14,442 feet.

These dikes consist of timber resting upon piles driven into the original bottom of the shoal, the crib-pockets being filled with material dredged from the channel and the cribs backed with dredged material.

To maintain a channel-bank, a single row of sheet-piling was driven along the channel-face of the cribs previous to dredging.

The back or lake sides of the dikes were protected from wave action by shorter sheet-piling.

In 1873 the channel was deepened to 16 feet by dredging for a width of 100 feet on each side of the axis of the canal, or a width of 200 feet in all, being thus limited by the fact that the sheet-piles, intended for a depth of 13 feet, have not sufficient penetration to admit of dredging to 16 feet for the full width of 300 feet.

Moreover, the single row of sheet-piling is insufficient to prevent leakage of the dike-filling through it into the channel, and it is necessary to re-enforce it with a double row, giving the latter, however, sufficient penetration to admit of subsequent dredging to a depth of 20 feet.

The entire timber structure is much decayed above water, and this portion should be renewed as soon as possible. Its condition has been duly reported in the Annual Reports for the last six years, and there is now nothing to add except that the condition becomes worse with each succeeding year. It has now been in place an average of twenty-one years.

The approved general project for remedial measures contemplates driving a double row of sheet-piling to a depth of 26 feet along the channel-face of each dike, dredging the area between the dikes to a depth of 20 feet, continuing the channel above and below the canal to the same depth in river and lake, and rebuilding the decayed portions of the timber superstructure, at an estimated cost of \$200,000, exclusive of the cost of the dredging.

Under the appropriation of \$75,000 made by the river and harbor act of August 11, 1888, the sum of \$70,000 (less contingent expenses) is being expended in continuing the construction of the new sheet-piling. At the close of the fiscal year 4,082 linear feet had been completed under the present contract. It is expected that the funds available will serve to complete about 8,200 linear feet, and that this will be accomplished on or before December 1, 1889, making a total of about 10,700 linear feet of new work, and leaving about 3,800 linear feet of the new sheet-piling yet to be constructed.

It is proposed to continue the sheet-piling to completion as rapidly as possible, and, if the funds made available are sufficient to warrant it, to begin dredging the channel to the depth of 18 feet and full width of 300 feet at the same time work is resumed on the sheet-piling under

the next appropriation. To carry this proposition into effect will require the sum of \$200,000, which should be granted at one time. This will leave the renewal of the decayed portions of the timber superstructure to be provided for by future appropriations, and for which the estimates submitted with the Report for 1888 are still considered sufficient.

The aggregate expended on this improvement to June 30, 1883, was \$621,662.70
Amount expended during the fiscal year ending June 30, 1889, was..... 33,461.31

Total expenditure to June 30, 1889.....	655,124.01
July 1, 1888, amount available	139.70
Amount appropriated by act of August 11, 1888.....	\$75,000.00
Allotted to Grosse Pointe.....	5,000.00
Difference to St. Clair Flats	70,000.00
	70,139.70
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	21,972.37
July 1, 1889, outstanding liabilities.....	11,488.94
July 1, 1889, amount covered by existing contracts.....	36,678.39
	70,139.70

{ Amount (estimated) required for completion of existing project	276,250.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	200,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L L 11.)

12. *Operating and care of St. Clair Flats Canal, Michigan.*—The canal is in immediate charge of a custodian, who, without additional compensation, also acts as inspector whenever any work is in progress.

During the first days of September, 1888, a "blockade" of vessels occurred at the canal, giving rise to much detention, damage to vessels and canal, and requiring a considerable expenditure to restore the channel. The demand for the immediate restoration of the channel was so imperative that the President of the United States authorized and directed the most energetic measures, and five dredges in all (with requisite tugs and dump-scows) were employed. Three of these were obtained by circular letters, and three by contract after advertisement in the newspapers, one dredge having been twice employed, once under each method.

They removed from the channel an aggregate of 56,117 cubic yards of material, for which they were paid the sum of \$16,665.43, the cost of supervision, etc., being \$852.83. The ordinary current expenses of operating and care of the canal, such as salary of custodian, trimming willows, etc., amounted to \$20,315.

The estimated cost of operating and care of the canal for the fiscal year ending June 30, 1890, is as follows:

Salary of custodian.....	\$1,500
Current repairs and contingencies which can neither be foreseen nor estimated for in detail, to include a fair proportion of the office of the superintending engineer at Detroit.....	3,500
Total	5,000

All of which is provided for by indefinite appropriation (section 4 of the river and harbor act of June 5, 1884).

(See Appendix L L 12.)

13. *Grosse Pointe Channel, Michigan.*—The difficulty reported last year as attending navigation over the flats off Grosse Pointe, at the

foot of Lake St. Clair (head of Detroit River), has increased, and remedial measures are loudly demanded. The obstruction can easily be removed by dredging a channel through it, but the amount of excavation required is so great that no improvement of value can be made without a very considerable expenditure of money.

The annoyance to shipping because of the insufficient depth of water on these flats must increase in proportion to the improvement of the water route at other points, and the consequent increase in the size and carrying capacity of the vessels engaged in the commerce of the Lakes. The proposed improvement is one link in the chain projected for the amelioration of the general navigation of the Lakes, and as the necessity is urgent no time should be lost in beginning the dredging.

The commerce passing this obstruction is essentially the same as that which passes St. Clair Flats Canal and Detroit River, amounting to about 20,000,000 tons per year, or an average of about 90,000 tons per day for the season of navigation.

The estimated cost of the improvement based upon a channel depth of 19½ feet is \$553,000. This depth will suffice for several years, and the cost of removing the additional half foot to attain the depth of 20 feet, recognized as that which it is desirable the channel should ultimately have in common with the entire route, would be out of proportion to the immediate benefit.

By the river and harbor act of August 11, 1888, the sum of \$75,000 was appropriated for "improving St. Clair Flats Ship Canal * * * all or any portion of which may, in the discretion of the engineer, be expended in dredging Grosse Pointe Channel."

After consultation with the representatives of the vessel interests, the conclusion was reached that it would be best to push the work already begun at St. Clair Flats Canal, to which end \$70,000 should be expended upon it, leaving \$5,000 for the removal of any small and well-defined obstruction that might be found at Grosse Pointe, as well as for the purpose of making such surveys as might be necessary before making a definite project. Consequently the matter of the improvement of Grosse Pointe Channel has remained in abeyance.

It is believed that the proposed improvement is both necessary and urgent. To accomplish valuable results, a large appropriation will be required at first. Unless this be granted the results will be unsatisfactory, and the eventual cost will be greatly increased. With an available sum of \$200,000 a narrow channel of the proposed depth can be opened, and will afford immediate, though insufficient, relief. Its width can subsequently be increased to such extent as may be necessary.

Amount appropriated by act of August 11, 1888	\$75,000
Allowed to improvement St. Clair Flats Canal	70,000
Difference to Grosse Pointe	5,000
July 1, 1889, balance available	5,000

(See Appendix L L 13.)

14. *Clinton River, Michigan.*—In 1870 the channel over the bar at the entrance to this river afforded a depth of only 3½ feet, whilst the depth in the river for some distance above was 10 feet.

A project for dredging a channel across the bar was approved and carried into effect in 1870. A project for the general improvement of the river from its mouth to the city of Mount Clemens was submitted in 1880, renewed in June, 1889, and approved by the Chief of Engineers under date of June 14, 1889. It contemplates a navigable depth of 8 feet for the entire distance, and involves closing a high-water channel and dredging a shoal at the lower end of Mount Clemens, opening a

straight channel across "Shoemaker's Bend;" closing "Cat-fish" (or Blind) Channel; and the construction of a revetment on the north side of the channel from the visible bank at the mouth to the requisite depth of water in Lake St. Clair; together with such dredging as may subsequently be found necessary to attain the desired navigable depth.

The operations reported last year as in progress, with a view to affording temporary relief, were completed at a cost of \$1,584.19, with very satisfactory results. These form no part of the general project, and their cost should not be deducted from the estimate therefor.

The city of Mount Clemens, by warranty deed approved by the Attorney-General of the United States, has conveyed to the Government the requisite right of way at "Shoemaker's Bend."

The balance available for the execution of a portion of the general project, remaining from appropriations of August 5, 1886, and August 11, 1888, is \$14,361.86. With this fund it is proposed to close the high-water channel and remove the shoal at Mount Clemens, and to make the cut across "Shoemaker's Bend." Should any balance then remain, it can be applied to closing Cat-fish Channel, and to such other work in the vicinity of the mouth of the river as it will suffice to accomplish.

The estimated cost of the approved project is \$32,926. The amount now available is \$14,361.86. Consequently the remainder to be appropriated is \$18,564.14. The work to be done in revetting the north side of the channel at the mouth is of such character that it can only be advantageously done when the funds applicable thereto are sufficient to carry it to completion without interruption. It is therefore recommended that the remainder of the estimate be appropriated in one sum.

The aggregate expended on this improvement to June 30, 1888, was..... \$25,581.88
The amount expended during the fiscal year ending June 30, 1889, was .. 1,556.26

Total expenditures to June 30, 1889..... 27,138.14

July 1, 1888, amount available \$3,500.00
(Covered by existing contracts) 1,807.62

Amount appropriated by act of August 11, 1888..... 5,307.62
10,000.00

15,307.62

July 1, 1889, amount expended during fiscal year, exclusive of liabilities
outstanding July 1, 1888 945.76

July 1, 1889, balance available 14,361.86

{ Amount (estimated) required for completion of existing project..... 18,564.14

{ Amount that can be profitably expended in fiscal year ending June 30, 1891 19,000.00

{ Submitted in compliance with requirements of sections 2 of river and
harbor acts of 1866 and 1867.

(See Appendix L L 14.)

15. *Detroit River, Michigan.*—Originally the channel at Lime Kiln Crossing, Detroit River, could not be depended upon for more than 13 feet of water, the ordinary depths being much affected by the direction and force of the wind.

As originally projected in 1874, the improvement at this point was to consist of a curved channel 300 feet wide, with a uniform depth of 20 feet, and the original estimate was based upon this project.

In 1883 it was wisely determined to so modify the project as to secure a straight channel, the least width of which should be 300 feet, with a somewhat greater width at each end, utilizing the work already done.

In 1886 this was further modified to the end that the width of the channel should be increased to 400 feet by removing an additional 100 feet from the western (American) side.

The appropriation of \$37,500 made by the river and harbor act of August 5, 1886, was applied towards this project, resulting in the completion of the 300 feet channel, and the removal of an additional cut 50 feet wide for nearly the whole extent of the improvement.

By the river and harbor act of August 11, 1888, the sum of \$130,500 was appropriated to complete this improvement. When tenders were called for it was found that the lowest bid was at such a price as would not only suffice to complete the 400 feet channel, but an additional width of 40 feet, and upon presentation of the facts to the Chief of Engineers the project was again modified, the authority being dated November 19, 1888.

Contract dated October 30, 1888, was entered into with Messrs. Dunbar & Sullivan for the work to be done under this appropriation. Drilling and blasting were actually begun (at the contractor's risk) on the 27th, or three days prior to the date of the contract, and were continued with great energy, day and night, until December 13, 1888.

The dredge worked steadily from November 21 to December 19, when further operations were stopped by the ice.

Work was resumed March 16, 1889, and by the close of the fiscal year an aggregate of 8,508 cubic yards of solid rock, and 30 yards of loose rock had been removed at a cost for excavation of \$37,720.44, and for contingent expenses of \$2,636.89.

The aggregate expended on this improvement to June 30, 1888, was.... \$572,449.89
The amount expended during the fiscal year ending June 30, 1889, was.. 40,357.33

Total expenditure to June 30, 1889..... 612,807.22

The funds now available being sufficient to complete the work, no estimate is submitted for further appropriations.

July 1, 1888, amount available..... \$160.52
Amount appropriated by act of August 11, 1888..... 130,500.00

130,660.52

July 1, 1889, amount expended during fiscal year, exclusive of
liabilities outstanding July 1, 1888..... \$27,495.77
July 1, 1889, outstanding liabilities..... 12,861.56
July 1, 1889, amount covered by existing contracts..... 90,303.19

130,660.52

(See Appendix L L 15.)

16. *Rouge River, Michigan.*—The approved project contemplates dredging Rouge River to a depth of 16 feet and width of 240 feet at the mouth, gradually narrowing to 100 feet at a distance of about 1,150 feet above, and then continuing this width to the bridge of the St. Louis and Wabash Railroad, a total distance of about 15,000 feet.

By the river and harbor act of August 11, 1888, the sum of \$10,000 was appropriated for beginning the work. This was expended under contract dated October 11, 1888, with James Rooney, of Toledo, Ohio, in the removal of 81,163 cubic yards of material at 11½ cents per cubic yard. The resulting channel is 16 feet deep, 240 feet wide at the mouth, and gradually narrowing to 100 feet at the upper end of Brady's dock, a distance of about 1,150 feet; and 60 feet in width at the bottom (two dredge cuts,) thence for an additional distance of about 7,600 feet, or a total of about 8,750 feet. In view of the degree of relief afforded, and the comparatively small cost of the work, the result is very satisfactory.

The estimated cost of completing the improvement is \$21,690.39, and it is recommended that the entire amount be appropriated in one sum, in which case the work can be completed by a single dredge of the kind used by Mr. Rooney in a length of time equivalent to one working season.

Amount appropriated by act of August 11, 1888.....	\$10,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$9,716.00
July 1, 1889, outstanding liabilities.....	159.00

9,875.00

July 1, 1889, balance available.....	125.00
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125.00

{ Amount (estimated) required for completion of existing project.....	21,690.39
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	21,700.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L L 16.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examinations of the following localities were made by the local engineer in charge, Colonel Poe, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers, concurring in the conclusions reached in these instances, has given no instructions to make further survey with the view to their improvement:

1. *False Presque Isle Harbor, Lake Huron, for a harbor of refuge.*—(See Appendix L L 17.)
2. *Au Gres River, Michigan, to deepen channel to village of Au Gres to ten feet depth.*—(See Appendix L L 18.)
3. *Au Sable River at Au Sable, Michigan, with view of twelve-foot channel and breakwater.*—(See Appendix L L 19.)
4. *Port Austin, Michigan, for breakwater.*—(See Appendix L L 20.)
5. *Lexington, Michigan, for breakwater.*—(See Appendix L L 21.)
6. *Forestville, Michigan, for breakwater.*—(See Appendix L L 22.)
7. *Pine River at St. Clair City, Michigan, to deepen channel from mouth to Belknap's brick yard to depth of sixteen feet.*—(See Appendix L L 23.)
8. *Quanicasssee River, Michigan, to deepen channel from mouth to village of Sebawaing to twelve feet.*—(See Appendix L L 24.)
9. *Port Sanilac, Michigan, for harbor of refuge.*—(See Appendix L L 25.)
10. *Algonac on St. Clair River, Michigan, with view of uniting north and south channels between Clark and Harsems Island.*—(See Appendix L L 26.)

It appearing from the report of the preliminary examination made by the local engineer that the following localities are worthy of improvement, and the public necessity therefor being apparent from the facts and reasons reported, which are concurred in by the Chief of Engineers, Colonel Poe was charged with and has completed their survey, the results of which will be found in Appendix L L.

1. *Thunder Bay River, Alpena, Michigan, for sixteen-foot channel from mouth to one mile above.*—(See Appendix L L 27.)

2. *Black River, at Port Huron, Michigan, to deepen channel from mouth to Grand Trunk Railroad bridge to depth of eighteen feet.*—(See Appendix L L 28.)

It appearing from the report of the preliminary examination made by the local engineer of *Detroit River, at Gross Pointe, Michigan, to dredge channel now in use to depth of twenty feet*, that the locality is worthy of improvement, and the public necessity therefor being apparent from the facts and reasons reported, which are concurred in by the Chief of Engineers, Colonel Poe was charged with its survey, the results of which will be submitted when received.

IMPROVEMENT OF HARBORS ON LAKE ERIE, WEST OF ERIE, PENNSYLVANIA—IMPROVEMENT OF SANDUSKY RIVER.

Officer in charge, Maj. L. Cooper Overman, Corps of Engineers. Division engineer, Col. H. L. Abbott, Corps of Engineers.

1. *Monroe Harbor, Michigan.*—The original project for the improvement of this harbor was adopted in 1835, when Monroe was a town of considerable importance, and when the navigable waters of the River Raisin were separated from the waters of Lake Erie by extensive shoals. It provided for cutting a canal through River Raisin Point between the river and the lake, 4,000 feet long and 100 feet wide, and protecting the entrance into the lake by parallel piers, the object being to afford a channel of entrance of navigable width, with a depth of 10 feet. Work was commenced in 1835 and has been continued from time to time since that date.

At the close of the last fiscal year there was a fair channel with a least depth of 10 feet, up to a point below Monroe where rock bottom exists, which is deemed sufficient for the present commerce of the port.

During the fiscal year ending June 30, 1889, the sum of \$5,000 was expended in pressing repairs and dredging in accordance with terms of the last appropriation. No other work was done during the fiscal year.

The total amount appropriated for this harbor has been \$220,515.27.

If the harbor is to be kept up there is need of extensive repairs to piers and canal revetment, in order to prevent their ultimate destruction. These are estimated to cost \$20,000, besides about \$6,000 needed for immediate repairs.

Amount appropriated by act of August 11, 1888.....	\$5,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	4,869.97
July 1, 1889, balance available.....	130.03

{ Amount (estimated) required for completion of existing project.....	20,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M M 1.)

2. *Toledo Harbor, Ohio.*—The original project provided for making the existing channel 200 feet wide and 12 feet deep through Maumee Bay, and this was amended from time to time, resulting in the adoption of the present project, which provides for a width of 200 feet at bottom and a depth of 16 feet at low water between the city of Toledo and deep water in Lake Erie.

The total amount appropriated for this harbor for the several projects for improving the *natural* channel, from 1866 to close of fiscal

year ending June 30, 1889, is \$719,046.71, all of which, except \$5,000, has been expended, and has resulted in obtaining a 15½-foot channel where before there was a narrow intricate channel with but 11 feet depth.

The estimated cost of the present project for natural channel was \$570,000, of which amount there has been appropriated \$524,346.91. The balance of \$46,000 yet required will not complete the project as originally estimated, owing to the time consumed in doing the work for want of adequate appropriation; the annual removal of deposits of each winter and spring repeated for thirteen years, and other necessary expenses, having absorbed at least \$100,000 of the original estimate. It will therefore require at least \$100,000 to complete the deepening and widening of the natural channel between Toledo and 16 feet of water in Lake Erie, after which an annual expenditure of about \$20,000 will be needed to maintain the dredged channel through the open bay, or until the straight channel improvement is completed.

The act of August 11, 1888, appropriated for continuing the improvement of Maumee River by a straight channel \$150,000; and for clearing the old channel \$5,000, for improving harbor at Toledo, Ohio.

A project for the expenditure of the appropriation of 1888, in accordance with the report of The Board of Engineers, was adopted, and a contract was made for dredging about 660,000 cubic yards along the projected straight channel.

Work has been carried on under this contract during last month of the fiscal year 1889. About 42,000 cubic yards of material was excavated and removed.

The small amount of work done on the straight channel as compared with the entire project is of no avail, nor can any comparisons yet be made.

There have been three appropriations for the straight channel, amounting to \$287,500, of which \$135,177.01 has been expended to June 30, 1889 (on two lines), and \$9,632.61 transferred to "old channel."

Great difficulty was had in obtaining satisfactory bids for the dredging required, owing to the existence of a combination among dredge men on Lake Erie to secure high prices for the work.

Straight channel.

July 1, 1888, amount available.....	\$1,022.89
Amount appropriated by act of August 11, 1888.....	150,000.00
	<hr/> 151,022.89
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$7,562.51
July 1, 1889, outstanding liabilities.....	770.00
July 1, 1889, amount covered by existing contracts.....	132,000.00
	<hr/> 140,332.51
July 1, 1889, balance available.....	<hr/> 10,690.38
{ Amount (estimated) required for completion of existing project.....	1,612,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891.....	250,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Old channel.

Amount appropriated by act of August 11, 1888.....	\$5,000.00
July 1, 1889, outstanding liabilities.....	30.35
July 1, 1889, balance available.....	<hr/> 4,969.65

{ Amount (estimated) required for completion of existing project.....	\$45,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M M 2.)

3. *Port Clinton Harbor, Ohio.*—In 1870 the channel at the entrance to this harbor was narrow and intricate, with a depth of only 5 feet.

The present project, adopted in 1875, provides for a pile revetment from the north shore of the Portage River, opposite the town, 967 feet into the lake, and two pile-piers, 200 feet apart, of an aggregate length of 4,100 feet, extending to the depth of 10 feet in the lake, with a view to maintaining a depth of 9 feet between them.

The act of August 11, 1888, appropriated \$5,000 for continuing improvement, and at the close of the fiscal year 1889 all had been expended, and has resulted in obtaining a depth of 8 feet from the lake to the town. The proposed improvement is only about one-half finished.

The total amount appropriated for this harbor to the close of the fiscal year ending June 30, 1889, has been \$53,000, all of which has been expended, and has resulted in obtaining a depth of 8 feet from the lake to the town. The proposed improvement is only about one-half finished.

Amount appropriated by act of August 11, 1888.....	\$5,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	4,799.43
July 1, 1889, balance available.....	200.57

{ Amount (estimated) required for completion of existing project.....	37,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M M 3.)

4. *Sandusky City Harbor, Ohio.*—The original depth in the channel through the outer bar was 10 feet, and greatest depth in bay about 12 feet.

The project adopted in 1880 provides for a channel through the outer bar and through the bay 200 feet wide, and parallel to the city docks 100 wide, the whole to be 15 feet deep.

An increased depth of 16 feet at low water in the old channel is recommended for this harbor by the officer in charge, on account of the increased size of vessels navigating the lakes. The estimated cost of this extra depth is \$61,000.

A project for a "straight channel" for this harbor, extending from the east end of the dock channel to the north end of Cedar Point, has received the sanction of Congress, and the act of August 11, 1888, appropriated \$35,000 with which to begin this improvement. This will materially shorten and improve the existing entrance. The estimated cost is \$96,712, an increase of only \$46,712 over the estimate for the project of 1880 as revised to give 16 feet depth. The balance of the estimated cost, viz., \$61,712, should be appropriated in one allotment, and can be profitably and easily expended in the fiscal year ending June 30, 1891.

Under the appropriation of August 5, 1886, the contract made for dredging to the extent of available funds, and under which work was commenced in November, 1886, was being continued at the beginning

of the fiscal year 1889 by the contractor, but with poor progress; it was completed August 12, 1888, and appropriation exhausted; 88,407 cubic yards of material was removed under the contract.

An annual removal of at least 10,000 cubic yards is necessary to maintain the unfinished channel, after which the additional dredging can be applied toward the completion of the channel to 200 feet in width and 15 feet in depth, or until new channel is available.

For the expenditure of the appropriation of August 11, 1888, for straight channel, a contract was made with Christopher H. Starke, of Milwaukee, Wis., at 17 cents per cubic yard. Work was commenced May 1, 1889, and was being continued at the close of the fiscal year. Good progress has been made and the contract was about one-third finished at end of June. All available funds for the straight channel improvement will be exhausted by end of October, 1889.

At the close of the fiscal year ending June 30, 1889, the sum of \$271,989.87 had been expended on old channel for this harbor, resulting in a channel through the outer bar about 150 wide, having a depth of about 15 feet, in which for a width of 50 feet there was a depth of 16½ feet, and through the bay up to a point 50 feet from the line of docks a width of 150 feet and depth of about 14½ feet.

July 1, 1888, amount available.....	\$649.13
Amount appropriated by act of August 11, 1888.....	40,000.00

40,649.13

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	7,518.34
July 1, 1889, outstanding liabilities.....	728.39
July 1, 1889, amounts covered by existing contracts.....	29,032.77
	<hr/> 37,279.50

July 1, 1889, balance available.....	3,369.63
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{ Amount (estimated) required for completion of existing project.....	66,712.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	45,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M M 4.)

5. *Sandusky River, Ohio.*—The present project, which was based on a survey made in compliance with the river and harbor act of 1880, provides for opening a channel 100 feet wide and 9 feet deep between the town of Fremont and the depth of 9 feet in Sandusky Bay, at an estimated cost of \$44,000.

During the years 1867 and 1872 the sum of \$30,000 was expended in opening a navigable channel with a depth of 8 feet from Sandusky Bay to Fremont, a distance of 17 miles. Since 1872 the cuts then made through the various bars have filled up.

At the close of the fiscal year ending June 30, 1883, the sum of \$21,500 had been appropriated for the present project, of which the sum of \$20,871.53 has been expended; and there was at the close of the season of 1888 a fair channel, with least depth of 8 feet, from Fremont, the head of navigation, to the lake. The last appropriation for this river was that of August 2, 1882.

The balance on hand, viz., \$628.47, was too small to attempt any further work last season.

July 1, 1888, amount available.....	\$628.47
July 1, 1889, balance available.....	628.47

{ Amount (estimated) required for completion of existing project.....	\$22,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M M 5.)

6. *Huron Harbor, Ohio.*—At the close of the fiscal year ending June 30, 1887, there was a good channel through the outer bar with a depth of 16½ feet, and between the piers with a depth of from 16 to 17 feet. The superstructure of both piers, except where repaired in 1884 and 1886, was in a decayed condition and needed immediate renewal.

The heavy gales of the springs of 1885, 1886, 1887, and 1888 did considerable damage to the piers and to the beaches, so that a breach was made at the inner end of east pier near the shore.

Immediate repairs were made during the year, but considerable repairs are still needed.

Up to the end of the fiscal year 1889 the sum of \$123,273.71 had been appropriated for this harbor, all of which has been expended or contracted for. A good channel, with least depth of 14 feet, was maintained until piers became dilapidated, where originally there was a sand-bar dry at low water.

The estimated cost of renewing the superstructure of the piers is \$22,000; \$19,500 has been appropriated. Repairs in addition to those contemplated when the estimate was submitted have been made necessary by the storms of 1884, 1885, 1886, 1887, and 1888, and the amount asked for to completely renew the piers has been correspondingly increased.

Amount appropriated by act of August 11, 1888.....	6,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$2,171.43
July 1, 1889, outstanding liabilities.....	250.10
July 1, 1889, amount covered by existing contracts.....	3,516.52
	<hr/> 5,938.05
July 1, 1889, balance available	<hr/> 61.95

{ Amount (estimated) required for completion of existing project	6,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	11,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M M 6.)

7. *Vermillion Harbor, Ohio.*—Before improvement, the mouth of the Vermillion River was closed by a sand-bar, upon which there was a depth of less than 2 feet. The original project consisted of parallel piers running out into the lake from each side of the mouth of the river, in order to secure a depth of 10 feet. This project has been amended from time to time, and now provides for a depth of 14 feet.

In 1878 the channel was about 70 feet wide with a depth of about 12 feet, and has since remained nearly permanent.

The act of August 11, 1888, made an appropriation of \$1,000 for this harbor. Only partial repairs to the piers can be made with the sum available, which repairs will be made during the fall of 1889.

At the close of the fiscal year ending June 30, 1889, the piers were in only fair condition; the depth in the channel was about the same as at close of the previous fiscal year. The amount appropriated to close of fiscal year 1889 has been \$118,942.32, all of which sum will be expended by end of the calendar year 1889.

Amount appropriated by act of August 11, 1888.....	\$1,000.00
July 1, 1889, balance available.....	1,000.00

{ Amount (estimated) required for completion of existing project	10,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M M 7.)

8. *Black River Harbor, Ohio.*—The present project for the improvement of this harbor provides for parallel piers 200 feet apart, running out to a depth of 16 feet in the lake.

Up to the close of the fiscal year ending June 30, 1889, and since 1826, there had been appropriated the sum of \$220,138.73, all of which has been expended or pledged under contract, and with which a channel with least depth of 16 feet has been obtained where originally there was but 3 feet at the entrance.

The act of August 11, 1888, appropriated \$10,000 for this harbor. The extension of pier and repairs to piers under contract were begun in April, 1889, and were completed by the end of June, 1889, and appropriation exhausted. The piers need considerable renewal of superstructure.

Only one-third of the proposed extension of the piers has been accomplished. This is the most important work, and should be completed as soon as funds sufficient are available.

The unexpected and extra repairs made and to be made at this harbor will increase the estimate for same, and the renewal and prolonging of the piers will cost at least \$12,000, so that the sum of \$20,000 is still needed to complete the existing project.

Amount appropriated by act of August 11, 1888.....	\$10,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1889.....	\$5,001.84
July 1, 1889, outstanding liabilities.....	837.77
July 1, 1889, amount covered by existing contracts.....	3,398.86
	<u>9,238.47</u>
July 1, 1889, balance available	761.53

{ Amount (estimated) required for completion of existing project	10,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	20,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M M 8.)

9. *Cleveland Harbor, Ohio.*—The original project for the improvement of the mouth of Cuyahoga River was adopted in 1825, and has been amended from time to time to gain increased depth. It consists of parallel piers about 200 feet apart running out to a depth of 16 feet in the lake.

When operations were commenced there was a long, low sand-bar where the river now empties into the lake, and the entrance was through a narrow, intricate channel with a depth of about 3 feet.

At the close of the fiscal year ending June 30, 1889, there had been expended about \$371,000, and there was, as a result, a good wide channel at the entrance of the harbor with a depth of from 14 to 18 feet between the railroad bridge at the inner end of the piers and the lake, with a pile protection work 620 feet long at the inner end of the west pier constructed in 1882.

Harbor of refuge.—The original project provided for an outer break-water starting from the lake shore about 700 feet west of the upper end of the old river bed.

The west breakwater runs out about due north a distance of 3,130 feet to a depth of 28 feet, and thence for 4,030 feet it runs nearly parallel to the shore, with a spur 100 feet long on the north side of the lake arm, 200 feet from its eastern end, in a depth of from 28 to 30 feet. It was originally proposed to protect the entrance to the harbor on the east side by extending the east pier at the mouth of the river 1,400 feet.

Amended projects changed this plan and now provide for a breakwater on the east side, which begins at a point on the prolongation of the arm of the west breakwater and 500 feet from it, extends eastward on the line about 3,500 feet, then inclines towards the shore in a depth of 26 feet of water and extends 2,000 feet, having an entrance 2,300 feet wide between the eastern end and the curve of 14 feet depth of water, or about 2,200 feet from shore.

For the expenditure of the appropriation of August 11, 1888, contracts were made for the construction of about 600 linear feet of the east breakwater. Operations were commenced in March, 1889, and were continued, when weather permitted, until end of this fiscal year. By that date the 600 feet of east breakwater was about one-half finished and will be completed to extent of available funds by October 30, 1889.

The amount expended during the fiscal year was \$58,571.25.

At the close of the fiscal year 1889 a total of about \$1,000,585.50 had been expended and 8,310 linear feet of breakwater had been finished, which completes the west breakwater and over 1,150 linear feet of the east breakwater, leaving to be built to complete the harbor of refuge about 4,400 linear feet of east breakwater.

The total amount appropriated for the harbor of refuge to July 1, 1889, is \$1,093,750, of which sum \$1,036,085.50, exclusive of outstanding liabilities, has been expended, less about \$37,000 applied to repairs to piers, dredging, etc., for Cleveland Harbor proper.

Amount appropriated by act of August 11, 1888	\$100,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$42,335.50
July 1, 1889, outstanding liabilities	1,792.44
July 1, 1889, amount covered by existing contracts	53,469.18
	<u>97,597.12</u>
July 1, 1889, balance available	<u>2,402.98</u>

{ Amount (estimated) required for completion of existing project	519,250.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	200,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M M 9.)

10. *Fairport Harbor, Ohio.*—The present project for the improvement of this harbor consists of parallel piers, 200 feet apart, running into the lake. It was adopted in 1825, and has been modified by prolonging the piers from time to time, so as to give increased depth, the object now being to afford a channel of navigable width and not less than 16 feet in depth.

When the work was commenced in 1826 the mouth of the river was closed by a sand-bar 1,200 feet wide, at times so hard and dry that teams could cross over it.

At the close of the fiscal year ending June 30, 1889, there was a fair channel between the piers with a least depth of 16 feet at low water, and in lake beyond end of piers with a least depth of 15½ feet at ordinary level of the lake, but not for full width needed.

During the fiscal year ending June 30, 1889, contracts were made and work commenced for necessary repairs to piers and for extension of the

west pier 80 linear feet. An agreement was made in the fall of 1888 for a small amount of dredging in the channel and a contract for dredging was entered into also with Q. Gillmore. Under these two agreements the channel was put in fair condition, and by May 15, 1889, it was restored to its required depth, but not to full width.

Extensive improvements as to docks and yards for receiving cargoes of iron ore and shipping coal have been made at Fairport Harbor by Pittsburgh capitalists. These improvements were continued during the fall of 1888, and it is expected that they will be further extended this season and the business of this harbor still further increased thereby.

Amount appropriated by act of August 11, 1888	\$10,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$2,659.35
July 1, 1889, amount covered by existing contracts	6,200.00
	<u>8,859.35</u>
July 1, 1889, balance available	<u>1,140.65</u>

{ Amount (estimated) required for completion of existing project	21,250.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	21,300.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix M M 10.)	

11. *Ashtabula Harbor, Ohio.*—The original project for the improvement of this harbor was adopted in 1826. Rock bottom was then found at 9 feet below the surface, and there was a depth of only 2 feet of water over bar at the entrance to harbor.

The present project contemplates the extension of the piers out to 16 feet depth of water, the removal of the decayed portions of both piers, and rebuilding with new material, also rock excavation and dredging to give channel of 160 feet width and full depth.

During the fiscal year 1889 the previous condition of the channel was restored by the removal of 2,414 cubic yards of soft material by contract.

At the close of the fiscal year ending June 30, 1889, there was a good wide channel 15½ to 16 feet deep from the lake into the harbor.

A contract was made during fiscal year for the excavation of rock from bar in lake and from channel between the piers to the extent of available funds.

The excavation was commenced and all the work required under the contract should be completed by end of August, 1889.

The channel through the outer bar is being excavated to 18 feet depth and full width. The channel between the piers is being excavated to 17 feet depth and of such width as the available funds will permit, viz., 80 feet, all in rock bottom. A contract was also made with B. S. Horton for the extension of the east pier 120 feet and repairs to piers, work to be completed August 31, 1889.

There has been appropriated for this harbor up to the close of the fiscal year ending June 30, 1889, \$427,401.21, of which \$404,203.97 has been expended and balance all pledged under existing contracts.

Amount appropriated by act of August 11, 1888	\$25,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$1,802.76
July 1, 1889, outstanding liabilities	4,660.00
July 1, 1889, amount covered by existing contracts	17,358.00
	<u>23,820.76</u>
July 1, 1889, balance available	<u>1,179.24</u>

{	Amount (estimated) required for completion of existing project.....	\$85,250.00
	Amount that can be profitably expended in fiscal year ending June 30, 1891	25,300.00
	Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M M 11.)

12. *Removing sunken vessels or craft obstructing or endangering navigation.*—In November, 1887, schooner *Joy* with cargo of iron ore was sunk near channel about 350 feet from lake end of east pier at Ashtabula Harbor, Ohio. The bids received, after advertisement, for its removal, being too high were rejected. Buoys have been placed to mark the position of the wreck.

During the summer it is proposed, if no favorable offer is received for removing what remains of the wreck, to explode dynamite cartridges under her and blow to pieces the timbers forming the wreck.

(See Appendix M M 12.)

EXAMINATIONS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examinations of the following localities were made by the local engineer in charge, Major Overman, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers concurring in the conclusions reached in these instances, has given no instructions to make further survey with the view to their improvement.

1. *Cowles Creek or Geneva, Ohio.*—(See Appendix M M 13.)

2. *Mouth of Chagrin River, near Willoughby, Ohio.*—(See Appendix M M 14.)

Major Overman also submitted a report of a preliminary examination of *Monroe Harbor, Michigan, to deepen channel to 16 feet* provided for in the act, and the locality was reported by him to be in his opinion worthy of improvement. (See Appendix M M 15.)

He estimates the cost of a 16-foot channel to be \$123,200. In my opinion the locality is not at present worthy of improvement to this extent.

He also submitted a report of a preliminary examination of *Conneaut Harbor, Ohio, for deepening and widening channel*, provided for in the act, in which he stated that with a line of railroad from the coal regions of Pennsylvania to this harbor the commerce would doubtless increase rapidly, and in that event the desired improvement to restore the harbor is in his opinion a worthy one. (See Appendix M M 16.) Having carefully considered the report made by the local engineer in this case, in my opinion the locality is not at present worthy of improvement; no instructions were therefore given for the surveys proposed.

IMPROVEMENT OF ERIE HARBOR, PENNSYLVANIA, AND DUNKIRK, BUFFALO, WILSON, OLCOTT, AND OAK ORCHARD HARBORS, AND TONAWANDA HARBOR AND NIAGARA RIVER, NEW YORK.

Officer in charge, Capt. Frederick A. Mahan, Corps of Engineers. Division Engineer, Col. H. L. Abbot, Corps of Engineers.

1. *Erie Harbor, Pennsylvania.*—The original survey of this harbor was made in 1819, at which time the channel was narrow and tortuous, with a depth of only 6 feet. In 1823 a plan for the improvement was adopted, and constitutes the present work at the entrance to the harbor, excepting some changes which have been required either on account of the age of the structures already built or other causes.

The piers have been extended from time to time and are now in fair condition.

The present project contemplated the extension of the piers to the 16-foot curve in the lake, and the maintenance of a channel of navigable width and 16 feet in depth from the harbor inside to the lake outside.

Operations have been prosecuted with more or less interruption and suspension [no work was done from 1838 to 1842, from 1846 to 1853, and from 1855 to 1864], and have resulted in much benefit to the harbor and its channel entrance. The work during the fiscal year consisted of the repairs to the piers and breakwaters, and of a survey of the peninsula to determine changes in the shore-line and the direction of the currents along the outside of the peninsula. The channel is now available to its full width for vessels drawing 16 feet of water.

To carry out the recommendations of the Board of Engineer Officers of June 14, 1882, \$10,000 of the amount available for the harbor is set aside to provide for the prompt construction of a dike at the neck of the peninsula in case of necessity.

On account of the high price paid for dredging authority was granted to try hydraulic dredging. A vessel has been chartered and the machinery ordered.

The total amount appropriated for this harbor to June, 1889, is \$791,867.23, of which \$729,490.72 have been expended, including outstanding liabilities, resulting in the construction of the north and south piers, north and south breakwaters, and in dredging the channel.

July 1, 1888, amount available.....	\$72,884.22
Amount appropriated by act of August 11, 1888.....	23,000.00

95,884.22

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$11,826.82
July 1, 1889, outstanding liabilities.....	5,500.64
July 1, 1889, amount covered by existing contracts.....	16,180.25

33,507.71

July 1, 1889, balance available.....	62,376.51
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{ Amount (estimated) required for completion of existing project.....	24,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891.....	24,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.....	

(See Appendix N N 1.)

2. *Preservation and protection of the peninsula at Presque Isle, Erie Harbor, Pennsylvania.*—In a report upon the examination of Erie Harbor, made in 1885, it was recommended that the neck of the peninsula be protected by a breakwater, and that the movement of sand around the eastern end of the peninsula, which threatens to close the harbor entrance, be arrested by the construction of jetties perpendicular to the shore of the peninsula, at an estimated cost of \$173,044.50.

Proposals were received on July 2, 1888, for the shore protection for the neck of the peninsula, and the work was awarded to Jacob Friday, of Pittsburgh, Pa. On account of the lateness of the season this contract was extended to August 1, 1889. Up to the close of the year he had finished a length of 805 feet of the protection.

Amount appropriated by act of August 11, 1888.....	\$60,000.00
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July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$200.25
July 1, 1889, outstanding liabilities.....	150.00
July 1, 1889, amount covered by existing contracts.....	59,649.75

60,000.00

tension of parallel piers from the mouth of Twelve-Mile Creek to the 12-foot curve in Lake Ontario, with the formation of a protected channel between the piers. The mouth of the creek was originally obstructed by a bar, upon which there was a depth of about 1 foot.

Before the commencement of operations by the United States the piers had been carried about 400 feet into the lake by private enterprise.

During the past year a protection 360 feet long was built to shield the shore of the lake from the action of waves in gales from the northeast, and prevent a breach being made into the harbor. A section of the west pier 150 feet long was rebuilt. At the end of the year dredging operations were completed and a channel with a least depth of 9½ feet obtained. The appropriation being exhausted, work had to stop.

The amount appropriated to June 30, 1889, is \$65,000, of which the sum of \$64,715.40 has been spent, with the result of extending the piers to the 8-foot curve in the lake and dredging to 9½ feet.

July 1, 1888, amount available.....	\$3,200.54
Refunded by A. N. Dwight, remission of duties on timber.....	269.54
Amount appropriated by act of August 11, 1888.....	5,000.00
	<hr/> 8,470.08

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$5,095.28
July 1, 1889, amount covered by existing contracts.....	3,090.20
	<hr/> 8,185.48

July 1, 1889, balance available.....	284.60
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{ Amount (estimated) required for completion of existing project.....	45,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix N N 6.)

7. *Olcott Harbor, New York.*—The project for the improvement of this harbor was adopted in 1866. It proposes to connect the deep water in Lake Ontario with the deep water in Eighteen-Mile Creek by the extension of two parallel piers from the mouth of the creek to the 11-foot curve in the lake, with the addition of a dredged channel between the piers. The project was modified in 1874 and in 1881 to provide for the removal of rock found to exist in the channel between the piers and for additional pier extension. The natural channel between the mouth of the creek and the lake was obstructed by a bar, upon which there was a depth of about 1½ feet.

Nothing was done during the year. A contract was made with McCullum & Lee for dredging. Work not yet begun. The piers are in good order.

Up to June 30, 1889, the sum of \$133,000 had been appropriated for this harbor, of which \$129,748.02 had been spent in the extension of the piers to the 9-foot curve in the lake and the formation between the piers of a channel of navigable width and about 7½ feet deep at low water.

July 1, 1888, amount available.....	\$2,792.34
Amount appropriated by act of August 11, 1888.....	5,000.00
	<hr/> 7,792.34

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$115.36
July 1, 1889, amount covered by existing contracts.....	4,425.00
	<hr/> 4,540.36

July 1, 1889, balance available.....	3,251.98
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{ Amount (estimated) required for completion of existing project.....	\$25,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix N N 7.)

8. *Oak Orchard Harbor, New York.*—The earliest project for the improvement of this harbor was adopted in 1836, the date of the first appropriation, and proposed the construction of an east and west break-water, approaching to within 200 feet of each other, and connecting at the opening with two parallel piers extending into the lake.

Subsequent modifications were extensions of the original project to provide for the removal of rock, and to adjust the harbor to the increased demand of commerce. The present project was adopted in 1881, the object being to extend the piers to the 12-foot curve in the lake, with the formation of a channel of navigable width and 12 feet deep at low water between the piers. The natural entrance into Oak Orchard Creek was narrow, with a depth of from 2 to 4 feet.

A shore protection 91 feet long was built to the east of the east pier. Very slight repairs were made to the west pier. All structures are in good order. Dredging was begun late in June, and is now going on.

The total amount appropriated for this harbor up to June 30, 1889, is \$200,000, of which the sum of \$196,191.63 has been spent, including outstanding liabilities. With this the piers have been extended to the 12-foot curve in the lake, and a navigable channel of 12 feet depth at low water has been obtained.

July 1, 1888, amount available.....	\$1,367.60
Amount appropriated by act of August 11, 1888	6,000.00
	<hr/> 7,367.60

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$1,061.43
July 1, 1889, outstanding liabilities	247.80
July 1, 1889, amount covered by existing contracts.....	2,250.00
	<hr/> 3,559.23

July 1, 1889, balance available.....	<hr/> 3,808.37
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{ Amount (estimated) required for completion of existing project.....	86,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix N N 8.)

IMPROVEMENT OF HARBORS ON LAKE ONTARIO, EAST OF OAK ORCHARD, NEW YORK.

Officer in charge, Capt. C. F. Palfrey, Corps of Engineers; Division Engineer, Col. H. L. Abbot, Corps of Engineers.

1. *Charlotte Harbor, New York.*—The original project for the improvement of this harbor, adopted in 1829, proposed to connect the deep water in the Genesee River with the deep water in the lake by parallel piers about 480 feet apart.

The present project, adopted in 1881, is for the extension of the piers to the 15-foot curve in the lake, with the formation, by dredging, of a channel between them of a navigable width and 15 feet in depth at low water.

The natural channel over the bar was tortuous, and in calm weather would admit, at ordinary stages of the lake, vessels drawing 8 feet.

The total amount expended from 1828 to June 30, 1889, is \$400,049.92, including outstanding liabilities; \$16,900 in addition is covered by existing contracts.

The amount expended from the adoption of the present project in 1881 to June 30, 1889, is \$81,971.52, including outstanding liabilities.

The total expenditures has resulted in extending the piers to the 13-foot curve in the lake, securing a channel between the piers of navigable width, and of not less than 12 feet in depth at extreme low water.

During the year superstructure has been repaired on 667 feet of pier, and renewed on 225 feet. Repairs have also been put in below water at two points; 15,494 cubic yards have been dredged from channel.

July 1, 1888, amount available	\$4,753.15
Amount appropriated by act of August 11, 1888	45,000.00

49,753.15

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$5,608.92
July 1, 1889, outstanding liabilities	137.75
July 1, 1889, amount covered by existing contracts	16,900.00

22,646.67

July 1, 1889, balance available	27,106.48
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{ Amount (estimated) required for completion of existing project	99,720.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	45,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix O O 1.)

2. *Great Sodus Harbor, New York.*—The earliest project for the improvement of this harbor, adopted in 1828, proposed the construction of two breakwaters from the east and west shores, approaching to within 500 feet of each other, and connecting at the opening with parallel piers extending into the lake. Subsequent modifications were extensions of the original project, to adjust it to the increased demands of commerce.

The present project was adopted in 1882, the object being to extend the piers to the 15-foot curve in the lake, and dredging a channel between the piers 15 feet deep at low water.

The natural channel would admit vessels drawing 8 feet at ordinary lake stage.

The total amount expended from 1829 to June 30, 1889, is \$419,641.27, including outstanding liabilities; \$9,000, in addition is covered by existing contract. The amount expended from 1831 to June 30, 1889, is \$62,101.15, including outstanding liabilities. The total expenditure has resulted in the extension of the west pier to the 14-foot curve in the lake, and of the east to the 9-foot, with a channel of navigable width and 12 feet deep at low water, between them.

The operations of the past year have been repairs, chiefly below water, sheet-piling 365 feet of pier, renewal of superstructure now in progress, and dredging now in progress.

July 1, 1888, amount available	\$5,079.88
Amount appropriated by act of August 11, 1888	24,000.00

29,079.88

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$9,057.78
July 1, 1889, outstanding liabilities	2,016.24
July 1, 1889, amount covered by existing contracts	9,000.00

20,074.02

July 1, 1889, balance available	9,005.86
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{ Amount (estimated) required for completion of existing project.....	\$52,440.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	25,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix O O 2.)

3. *Little Sodus Harbor, New York.*—The earliest project for the improvement of this harbor was adopted in 1829, and has since been variously modified. The first appropriation was made in 1852. The early project proposed the partial closing of the opening between the bay and the lake by lateral dikes connected with two parallel piers extending into the lake.

The present project, which is an expansion of the earlier ones, was adopted in 1881, and is designed to afford a channel of navigable width of not less than 15 feet depth at low water.

The total amount expended from the date of the first appropriation in 1852 to June 30, 1889, is \$288,896.12, including outstanding liabilities.

The amount expended from the adoption of the present project in 1881, to June 30, 1889, is \$54,453.35, including outstanding liabilities. The total expenditure has resulted in the extension of the pier to the 12-foot curve in the lake, securing a channel between the piers of navigable width and 10 feet in depth at extreme low water.

The operations of the fiscal year have been repairs, and renewal of superstructure on portions of west pier and of east breakwater, now in progress.

July 1, 1888, amount available	\$7,027.53
Amount appropriated by act of August 11, 1888	16,000.00
	<hr/> 23,027.53
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$5,197.62
July 1, 1889, outstanding liabilities.....	8,733.26
	<hr/> 13,930.88
July 1, 1889, balance available	<hr/> 9,096.65

{ Amount (estimated) required for completion of existing project.....	46,600.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	32,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix O O 3.)

4. *Oswego Harbor, New York.*—The earliest project for the improvement of this harbor was adopted in 1827, and proposed to inclose an area at the mouth of the river by extending jetties from the shore into the lake, joining the outer ends by a breakwater, but leaving an opening through which to enter the harbor.

The project was completed in 1869 and forms the present inner harbor.

The present project was adopted in 1870, and consists of a breakwater 5,800 feet in length, parallel to the old west breakwater, and 1,100 feet in advance of it. The estimated cost was \$1,161,682. It was subsequently modified by the proposed construction of an east breakwater 2,700 feet in length, the reduction to 350 feet of the opening between the east end of the west breakwater and the north end of the light-house pier, the construction of spurs along the face of the outer west breakwater to reduce the effect of accumulated seas, and for deepening by dredging the inner harbor at the mouth of the Oswego

River, and by the proposed removal of the east breakwater, now in progress.

The object of these improvements was to give protection to the city docks and wharves, and to the commerce of the harbor and lake a depth suitable for the heaviest-draught vessels on the lakes.

The natural entrance to the mouth of the river was shallow and difficult of access.

The total amount expended from the date of the first appropriation in 1826, to June 30, 1889, is \$1,621,236.59, including outstanding liabilities; \$14,700 in addition is covered by existing contract.

The amount expended from the adoption of the present project in 1870 to June 30, 1889, is \$1,147,903.86, including outstanding liabilities.

The total expenditure has resulted in the completion of the originally projected harbor, the completion of the west breakwater, with the reduction of 350 feet of the opening between the east end of west breakwater and the north end of the light-house pier, the construction of 213 linear feet of the east breakwater, the completion of one spur-crib, and the deepening of the river mouth to a depth of 15 feet at low water, securing full protection to the docks and wharves west of the river mouth, and channels of entrance 16 feet deep and 350 feet wide each to the inner and outer harbors and 15 feet deep at low water.

Early in December, 1884, a severe northwest storm caused a breach in the west breakwater 145 feet in width, necessitating repairs for a length of 100 feet each side of the breach. This portion of the breakwater has been repeatedly breached. To remove and rebuild the old work, the officer in charge estimates, would cost \$80,000.

The operations of the fiscal year have been repairs of damage by storm and removal of east breakwater, now in progress.

July 1, 1888, amount available	\$27, 638. 04
Amount appropriated by act of August 11, 1888.....	100, 000. 00

127, 638. 04

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$7, 057. 54
July 1, 1889, outstanding liabilities	6, 324. 42
July 1, 1889, amount covered by existing contracts.....	1, 470. 00
	14, 851. 96

July 1, 1889, balance available	112, 786. 08
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{ Amount that can be profitably expended in fiscal year ending June 30, 1891	60, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix O O 4.)

5. *Sacket's Harbor, New York.*—The project for the improvement of this harbor was adopted in 1881, and proposed the deepening of the harbor over an area of about 15 acres to a depth of 12 feet at low water. The depth previously existing was less than 8 feet over a large part of its area.

In 1826 and 1828 the sum of \$6,000 was expended in clearing and deepening the harbor.

The total amount expended from 1826 to June 30, 1889, is \$14,256.09. The amount expended from the adoption of the present project to June 30, 1889, is \$8,256.09, and has resulted in the removal of 24,010 cubic yards of sand, mud, and gravel. With the completion of that work the harbor had a depth of 12 feet at low water over about 6 acres of its area, except in a small part where the presence of rock in place limited the depth to a little less than 12 feet.

The operations of the fiscal year have been the building of 164 feet of stake and fascine jetty, connecting harbor-crib with Ship-house Point, and the placing of two mooring-cleats on harbor-crib.

July 1, 1888, amount available	\$60. 14
Amount appropriated by act of August 11, 1888	2,000. 00
	<hr/> 2,060. 14
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	1,503. 94
	<hr/> 556. 20
{ Amount (estimated) required for completion of existing project	13,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix O O 5.)	

**EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH
REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST
11, 1888.**

The required preliminary examinations of the following localities were made by the local engineer in charge, Captain Palfrey, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers, concurring in the conclusions reached in these instances, has given no instructions to make further survey with the view to their improvement.

1. *Genessee River, New York, from a point south of the present harbor and above the village of Charlotte, extending southerly a distance about 3,000 feet.*—(See Appendix O O 6.)

2. *Channel connecting Irondequoit Bay with Lake Ontario, for harbor of refuge at Irondequoit Bay, New York.*—(See Appendix O O 7.)

3. *Harbor at Troutberg, New York.*—(See Appendix O O 8.)

4. *Harbor at mouth of Salmon River, Lake Ontario, New York.*—(See Appendix O O 9.)

5. *Black River, New York, from Brownville to Lake Ontario.*—(See Appendix O O 10.)

Captain Palfrey also submitted a report of preliminary examination, provided for in the act, of *Cape Vincent Harbor, New York, to establish a breakwater*, and the locality was reported by him to be, in his opinion, worthy of improvement. Having carefully considered the report made by the local engineer, in my opinion this locality is not at present worthy of improvement, and no instructions were therefore given for the survey proposed. (See Appendix O O 11.)

The act also provides for an examination or survey for harbor of refuge at *Frontberg, on south shore of Lake Ontario, New York*. No such locality could be found. A report on preliminary examination of harbor of *Troutberg, south shore of Lake Ontario, New York*, will be found in Appendix O O 8.

Captain Palfrey was also charged with examination of *water-way around Niagara Falls, of capacity and facilities sufficient to float merchant ships and ships-of-war of modern build, drawing 20 feet of water, said water-way to commence in a navigable part of Niagara River, in Niagara County, New York, at or near Tonawanda, and to end in the navigable waters of said river below said falls, or in the navigable waters connected therewith*, and his report thereon is submitted herewith.

The estimates presented are as follows :

Route No. 4.—Wilson or Twelve-Mile Creek Line.

[Length, 18.35 miles ; 18 lifts.]

Estimated cost with single locks.....	\$24,201,550
Estimated cost with double locks.....	29,347,900

Route No. 5.—Olcott or Eighteen-Mile Creek Line.

[Length, 25.28 miles ; 18 lifts.]

Estimated cost.....	\$23,617,900
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(See Appendix O O 12.)

IMPROVEMENT OF OGDENSBURG HARBOR ON THE RIVER ST. LAWRENCE, OF HARBORS ON LAKE CHAMPLAIN, AND OF GRASS AND TICONDEROGA RIVERS, NEW YORK, AND OF OTTER CREEK, VERMONT.

Officer in charge, Maj: Milton B. Adams, Corps of Engineers. Division Engineer, Col. H. L. Abbot, Corps of Engineers.

1. *Ogdensburgh Harbor, New York.*—The present project for the improvement of this harbor, which was adopted in 1882, contemplates the deepening of the channels along the city front, and the prolongation of the lower reach of the Oswegatchie to deep water in the St. Lawrence River, so as to afford a depth of 15 feet in the channels, and 16 feet on the outer bar at extreme low water.

When operations were commenced at this harbor the channels afforded depths of 5 to 12 feet only, and now there are two good channels from deep water in the St. Lawrence to the nearest docks or wharves, in which water from 15 to 16 feet deep is afforded, and a channel 12 feet deep and 150 feet wide has been made along the city front and is undergoing deepening to 15 feet.

At the close of operations August 31, 1887, the channel along the city front had been made 15 feet deep, and 100 feet wide from its lower end to a point opposite Hannan's Dock; a total length of 2,900 feet, and all available funds were consumed. The appropriation of August 11, 1888, has been pledged under contract and will be expended in widening and deepening the existing channels. The total amount expended from the date of the first appropriation in 1852 to June 30, 1889, has been \$146,886.78, and from the adoption of the present project, \$36,886.78.

Amount appropriated by act of August 11, 1888.....	\$15,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$206.91
July 1, 1889, amount covered by existing contracts.....	12,286.40
	<hr/> 12,492.31

July 1, 1889, balance available	<hr/> 2,507.69
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{ Amount (estimated) required for completion of existing project.....	25,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	25,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix P P 1.)

2. *Grass River (at Massena), New York.*—The project for the improvement of this river was adopted in 1881, and has for its object the formation of a channel with a least depth of 4 feet, and a least width of 40

feet from the St. Lawrence River to the village of Massena, a distance of about $7\frac{1}{2}$ miles by water.

The natural depth of the shoal places is about 2 feet. The act of August 2, 1882, appropriated \$3,000 for this work. There remained unexpended at the close of last fiscal year, \$2,948.60, which was directed by the river and harbor act of August 11, 1888, to be expended in dredging operations, according to the original plan.

Work commenced by dredging at the rapids in September and terminated in October, 1888, the funds being then consumed.

There was 1,668 $\frac{1}{2}$ cubic yards removed at a cost of \$1.76 per yard. A cut 800 feet long and 26 feet wide was made, which lacked about 25 feet of carrying it through the shoal, consequently navigation has as yet derived no benefit from the improvement.

July 1, 1888, amount available	\$2,948.60
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	2,948.60

{ Amount (estimated) required for completion of existing project	6,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	6,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix P P 2.)

3. *Breakwater at Rouse's Point, Lake Champlain, New York.*—The project for this improvement was adopted in 1885 and contemplates the construction of a breakwater composed of rubble and large stone on a straight line from Stony Point until the 18-foot curve in the lake is reached, a total distance of 2,000 feet.

The estimated cost of the breakwater is \$110,000. Work was commenced by contract September 1, 1885, and has been in progress since that time. The first and second contracts are completed, and comprise the sections, 800 feet long, extending from shore to the 12-foot curve, and the section from there to the 14-foot curve, 550 feet, making the total length of completed work 1,350 feet.

A contract for further extension of this work, 125 feet, was entered into under date of November 2, 1888, and the rubble-stone for the foundation has been placed. Operations are now suspended, as time for settlement in the foundation should be allowed before the large crowning and facing stones are added. It is expected that work will be resumed so as to complete the contract on time, November 30, 1889, and that the available funds will then be consumed.

There has been \$62,790.03 expended on this work to June 30, 1889, including outstanding liabilities.

The good effects of the improvement are apparent in the increased shelter afforded at the docks and wharves by the portion of the breakwater which has been finished.

July 1, 1888, amount available	\$328.27
Amount appropriated by act of August 11, 1888	13,500.00

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	13,828.27
July 1, 1889, outstanding liabilities	\$7,786.53
July 1, 1889, amount covered by existing contracts	331.74
July 1, 1889, amount covered by existing contracts	4,118.20
	12,236.47

July 1, 1889, balance available	1,591.80
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{ Amount (estimated) required for completion of existing project.....	\$41,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	25,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix P P 3.)	

4. *Channel between North and South Hero Islands, Lake Champlain, Vermont.*—This is a new work. In compliance with a resolution of the Senate of the United States, dated January 15, 1887, a report of an examination of the above channel was submitted and printed as Senate Ex. Doc. 38, Forty-ninth Congress, second session (Appendix O O 11, of the Report of the Chief of Engineers for 1887).

The proposed improvement provides for the removal of about 12,000 cubic yards (mostly bowlders) at the west end of "the Gut" channel, and 4,000 cubic yards of clay and gravel from its eastern end.

The river and harbor act of August 11, 1888, appropriated \$10,000 for the work, which has been placed under contract at such favorable figures that this sum will be sufficient for the completion of the improvement.

Operations are soon to be commenced and are to be completed September 30, 1889.

Amount appropriated by act of August 11, 1888.....	\$10,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$310.78
July 1, 1889, amount covered by existing contracts.....	7,984.00
	<hr/> 8,594.78

July 1, 1889, balance available	1,405.22
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See Appendix P P 4.)

5. *Breakwater at Gordon's Landing, Lake Champlain, Vermont.*—The project for this improvement was adopted in 1887, and has for its object the construction of a stone breakwater, composed of rubble and large stones, extending in a straight line to the 16-foot curve in the lake, for the purpose of increased shelter to a landing on the west shore of Grand Isle, Lake Champlain.

Work of construction commenced August 11, 1887, and has been progressing under contract since then. The first contract comprises the construction of 500 feet shore section; work is well advanced, and the contract will probably be completed by September of this year.

Nearly all the rubble-stone required for the 150 feet extension to the shore section has been placed, and it is expected that the second contract, which comprises the construction of the above 150 feet of extension, will be completed by the close of this season's operations, practically consuming the available funds.

The officer in charge recommends that the work be terminated at 675 feet in length, instead of 800 feet, as originally contemplated, which recommendation has been approved.

July 1, 1888, amount available	\$1,671.68
Amount appropriated by act of August 11, 1888	10,000.00
	<hr/> 11,671.68

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$4,739.42
July 1, 1889, outstanding liabilities (new contract).....	376.11
July 1, 1889, amount covered by existing new contracts.....	5,520.40
	<hr/> 10,635.93

July 1, 1889, balance available	1,035.75
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{ Amount (estimated) required for completion of modified project	\$6,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	6,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix P P 5.)

6. Plattsburgh Harbor, New York.—The first appropriation for the improvement of this harbor was in 1836. The project adopted and its modifications have resulted in the construction of 1,250 feet of breakwater, the protection of a portion of the beach, and the dredging of shoal areas within the harbor.

Under the appropriation of August 11, 1888, proposals were invited and a contract made for dredging 28,000 cubic yards from the shoal areas within the harbor. This contract is to be completed in November, 1889, and will complete the project of 1870.

The total amount expended at this harbor to June 30, 1889, has been \$143,411.17, of which amount \$57,911.17 was expended since the adoption of the modified project of 1870.

July 1, 1888, amount available	\$477.42
Amount appropriated by act of August 11, 1888	7,000.00
	<hr/> 7,477.42
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$388.59
July 1, 1889, amount covered by existing contracts	3,640.00
	<hr/> 4,028.59
July 1, 1889, balance available	3,448.83

{ Amount (estimated) required for repairs	20,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix P P 6.)

7. Burlington Harbor, Vermont.—This improvement dates from 1836. Modifications of the original plan have been made from time to time so as to afford adequate protection to the increasing commercial and shipping interests of the harbor. The last modification, made in 1886, provides for further extension of the breakwater, both to the north and to the south, with its gradual withdrawal, as it is prolonged into water about 30 feet deep, instead of 38 feet, to reduce the cost of the work.

Operations during the past year consisted in the completion of the 240 feet of southern extension to the breakwater and in placing 4,988 cubic yards of rubble-stone in the foundation of 400 feet of extension northward. The contract under which the above foundation is being constructed also comprises the building of ten cribs, the sinking of the same, and covering them with a superstructure of large facing stones with rubble-stone core. This contract is not to be completed until the close of the next season of operations, and will practically consume the available funds.

It is thought that operations for some years now should be limited to maintenance.

July 1, 1888, amount available	\$1,645.44
Amount appropriated by act of August 11, 1888	35,000.00
	<hr/> 36,645.44
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$3,675.38
July 1, 1889, outstanding liabilities	3,309.03
July 1, 1889, amount covered by existing contracts	27,091.78
	<hr/> 34,076.19
July 1, 1889, balance available	2,569.25

{ Amount (estimated) required for completion of existing project.....	\$149,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1891, for repairs.....	20,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix P P 7.)	

8. *Otter Creek, Vermont.*—The project for this improvement proposes the formation of a channel of navigable width and a least depth of 8 feet from Vergennes, Vt., to Lake Champlain.

No operations have been carried on since the improvement of Bull Brook Bend and vicinity, in 1884, when this obstruction was entirely removed, so as to afford a good channel 75 feet wide and 8 feet deep at low water.

The appropriation of August 11, 1888, has been pledged under contract and will be applied in the removal of 3,000 yards that have filled in at Bull Brook Bend since 1884, and in the removal of 17,000 cubic yards at other obstructing shoals. The contract is to be completed this season and will consume the available funds.

There has been expended to June 30, 1889, \$33,439.67. The channel at several shoals in the stream and at the mouth is still to be widened and deepened to complete the project for improvement, and unfortunately is not then likely to prove permanent.

July 1, 1888, amount available.....	\$648.34
Amount appropriated by act of August 11, 1888	2,500.00

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$88.01
July 1, 1889, amount covered by existing contracts.....	2,800.00
	<u>2,888.01</u>

July 1, 1889, balance available	<u>260.33</u>
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{ Amount (estimated) required for completion of existing project	22,106.33
Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix P P 8.)

9. *Ticonderoga River, New York.*—The project for this improvement was adopted in 1881, its object being to afford a channel of navigable width and a least depth of 8 feet at low water from Ticonderoga Village to Lake Champlain, a distance of about 2 miles. The original estimated cost of the improvement was \$42,516, of which amount \$14,500 has been appropriated, and as expended has resulted in an improved channel, but one that is unfortunately far from permanent.

The appropriation of August 11, 1888, has been pledged under contract, work is progressing, and the contract will be completed July 10, when the funds will be exhausted.

July 1, 1888, amount available	\$58.71
Amount appropriated by act of August 11, 1888	2,500.00

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$494.60
July 1, 1889, outstanding liabilities.....	1,695.98
July 1, 1889, amount covered by existing contracts.....	368.13
	<u>2,558.71</u>

{ Amount (estimated) required for completion of existing project.....	28,016.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix P P 9.)

10. *Narrows at Lake Champlain, New York and Vermont.*—The project for this improvement was adopted in 1885, and has for its object the removal of such obstructions in the channel as will afford a least depth of 12 feet and a least width of 150 feet from Whitehall to the Elbow, and 12 feet depth and 200 feet width along Cedar Mountain and across Kenyon's Bay.

The entire undertaking was estimated to cost \$80,000, of which amount \$45,000 has been appropriated.

The contracts for the removal of the rock-reef at the Elbow, near Whitehall, N. Y., and for the dredging of 101,101 cubic yards from Kenyon's Bay, near Benson's Landing, Vermont, have been completed and closed.

The appropriation of August 11, 1888, has been pledged under contract for the removal of 60,000 cubic yards from the channel between Whitehall and the Elbow, and for the removal of 40,000 cubic yards from the channel near Cedar Mountain.

Work is progressing under the new contract, 22,517 cubic yards have been removed to date, and the contract is to be completed this season, which will practically complete the improvement according to project and leave a balance of some \$3,000 on hand.

The work will have been completed at a little more than half the estimated cost, which is due to the dredging having been accomplished at 17 cents and 10⁸/₁₀ cents per yard instead of 25 cents and 30 cents as estimated.

July 1, 1888, amount available	\$1,758.56
Amount appropriated by act of August 11, 1888	15,000.00
	<hr/> 16,758.56
July 1, 1889, amount expended during fiscal year, exclusive of	
liabilities outstanding July 1, 1888	\$3,299.34
July 1, 1889, outstanding liabilities	243.19
July 1, 1889, amount covered by existing contracts	8,368.16
	<hr/> 11,910.69
July 1, 1889, balance available	4,847.86

(See Appendix P P 10.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examinations of the following localities were made by the local engineer in charge, Major Adams, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers, concurring in the conclusions reached in these instances, has given no instructions to make further survey with the view to their improvement:

1. *Lake George, New York, with view of placing buoys and improving channel.*—(See Appendix P P 11.)

2. *Swanton Harbor, Vermont, as to what changes are necessary in present improvements.*—(See Appendix P P 12.)

The required preliminary examination of the harbor of *Plattsburgh, New York, for extension of 300 feet on north end of the breakwater*, was made by the local engineer, and the locality reported worthy of improvement. This conclusion being concurred in by the Chief of Engineers, and the report of the preliminary examination containing information sufficient to indicate to Congress the probable cost of the work required, no further report or survey appeared to be necessary.

Estimated cost, \$32,500, to be applied to the extension proposed, and to repair of the existing breakwater. (See Appendix P P 13.)

It appearing from the report of the preliminary examination made by the local engineer that the following localities are worthy of improvement, and the public necessity therefor being apparent from the facts and reasons reported, which are concurred in by the Chief of Engineers, Major Adams was charged with and has completed their survey, the results of which will be found in Appendix P P:

1. *Salmon River, New York, from railroad bridge at Fort Covington to the international line, with a view of deepening the channel to 7 feet.*—(See Appendix P P 14.)

2. *Shoals between the Sister Islands and Cross-over Light, in the Saint Lawrence River, New York.*—(See Appendix P P 15.)

3. *Great Chazy River, New York, from its mouth on Lake Champlain to Champlain Village.*—(See Appendix P P 16.)

PACIFIC COAST.

IMPROVEMENT OF NAPA RIVER, AND OF THE HARBORS AT OAKLAND, REDWOOD, SAN LUIS OBISPO, WILMINGTON, AND SAN DIEGO, CALIFORNIA.

Officer in charge, Maj. W. H. H. Benyaurd, Corps of Engineers. Division Engineer, Col. G. H. Mendell, Corps of Engineers.

1. *Napa River, California, officer in charge, Col. G. H. Mendell, Corps of Engineers, until March 21, 1889.*—The project is to remove all snags, stumps, etc., from the bed and banks of the river, and to make a channel 4 feet deep at low tide and 75 feet wide from the mouth of the river to the bridge at Napa City, and 50 feet wide from that point to Vernon Mills.

During the past year all obstructions to navigation in the way of snags, stumps, etc., were removed from the bed and banks of the river from Vernon Mills to Carr's Bend; the gravel-bar near steam-boat landing was excavated to low water, and the rocky stumps near "Lone Tree Reef" were removed.

The total amount appropriated for this improvement to June 30, 1889, is \$7,500. The total amount expended is \$4,385.45.

The \$20,100 asked for is to be applied to dredging the channel from the mouth of the river to Vernon Mills.

Amount appropriated by act of August 11, 1888.....	\$7,500.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	4,385.45
July 1, 1889, balance available.....	3,114.55

{ Amount (estimated) required for completion of existing project.....	20,100.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	20,100.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix Q Q 1.)

2. *Oakland Harbor, California.*—Officer in charge, Col. G. H. Mendell, Corps of Engineers, until March 21, 1889. The natural low-water depth in the harbor was about 2 feet. The present depth is 10 feet. The project now in course of execution contemplates a channel 18 to 20 feet deep at low water.

The general features of the project are:

(1) Two stone jetties, raised 1 foot above high water, extending into San Francisco Bay;

(2) A tidal canal, 400 feet wide and 8 feet deep, uniting the head of the harbor with the adjacent basin of San Leandro;

(3) A dam at the mouth of San Leandro Bay;

(4) Increase of tidal prism by dredging a basin; and

(5) Dredging interior channels.

The tidal basin was excavated during the past year to the extent of 126,548 cubic yards of material. The spoil was deposited securely ashore behind embankments. The tidal canal was commenced and 96,530 cubic yards of material was removed and deposited in an embankment to retain the spoil from the tidal basin. From the jetty channel 116,748 cubic yards of material was removed and deposited behind the north jetty. The contractor for stone-work delivered on the south jetty 3,954.42 tons of stone, and laid up dry masonry facing amounting to 15,489 square feet. These different operations were carried on by contract.

These operations will be continued during the coming season under existing contracts.

The appropriation asked for is to be applied to a continuation of the excavation of the tidal canal, and to dredging in the tidal basin and in the channels.

The total amount appropriated for this work is \$1,284,600, and the total amount expended, including outstanding liabilities, is \$989,356.35.

July 1, 1888, amount available	\$3, 043. 95
Amount appropriated by act of August 11, 1888	350, 000. 00
	<hr/> 356, 043. 95
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$59, 691. 83
July 1, 1889, outstanding liabilities	808. 47
July 1, 1889, amount covered by existing contracts	244, 398. 75
	<hr/> 304, 899. 05

July 1, 1889, balance available	51, 144. 90
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{ Amount (estimated) required for completion of existing project	1, 241, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	500, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix Q Q 2.)

3. *Redwood Harbor, California.*—Officer in charge, Col. G. H. Mendell, Corps of Engineers, until March 21, 1889. The project is to dredge Redwood Slough adjacent to Redwood City for a distance of 6,000 feet to accommodate the vessels trading at this port. These vessels have a capacity of 50 or 60 tons.

Last year the channel was dredged for a length of 3,700 feet. Operations were continued this season with the Government dredge, and at the close of the fiscal year the cut had been advanced to within a short distance of the upper limit of the projected channel.

The total amount of material removed was about 36,000 cubic yards. Operations will be continued to the extent of the available funds in finishing the cut, and in widening, straightening, and deepening portions dredged last year. These operations will complete the present project.

The total amount appropriated for this harbor is \$15,400, and the total amount expended, including outstanding liabilities, is \$12,986.41.

July 1, 1888, amount available.....	\$1,668.84
Amount appropriated by act of August 11, 1888.....	7,400.00
	<hr/> 9,060.84

July 1, 1889, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1888.....	\$5,913.12
July 1, 1889, outstanding liabilities.....	734.13
	<hr/> 6,647.25

July 1, 1889, balance available.....	2,413.59
(See Appendix Q Q 3.)	

4. *San Luis Obispo Harbor, California.*—The project is intended to secure a protected anchorage by the construction of a breakwater along Whaler's Reef, extending from Point San Luis to Whaler's Island, and thence to a point where the reef rises above high water. The total length of the structure, when completed, will be about 2,300 feet.

The work was commenced last February with the appropriation of \$25,000, made by the act of August 11, 1888. At the close of the fiscal year the contractor had deposited 2,812 tons of rock on the line of the breakwater, very nearly completing that portion of the structure between Point San Luis and Whaler's Island.

Work will be continued the coming season with the balance of the appropriation on hand.

The estimate herewith is intended to continue the construction beyond Whaler's Island.

Amount appropriated by act of August 11, 1888.....	\$25,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$5,805.51
July 1, 1889, outstanding liabilities.....	400.00
July 1, 1889, amount covered by existing contracts.....	18,671.10
	<hr/> 24,876.61
July 1, 1889, balance available.....	<hr/> 123.39

{ Amount (estimated) required for completion of existing project.....	259,900.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	100,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix Q Q 4.)

5. *Wilmington Harbor, California.*—The present project is intended to secure a depth from 14 to 16 feet at mean low tide. Previous to the commencement of the improvement, there was a depth not to exceed 1 foot at the entrance at low tide; the operations have resulted in securing a greatly increased width and depth of channel. A depth of not less than 12 feet can now be carried throughout the entire length of the channel.

It is intended to still increase this depth by dredging and extending the jetties.

These operations will be carried on during the coming season, and in the future, under the existing project, to the extent of the funds made available.

No dredging was done during the past year, owing to the failure to obtain reasonable bids for the work, though proposals were twice solicited by advertisement. The officer in charge states that he expects to have this work done by other parties, owning dredging outfits, at a price that may be considered reasonable.

The only work done on the jetties consisted in raising and strengthening a portion of the east jetty, which was endangered by high tides.

The total amount appropriated for this work is \$870,000, and the total amount expended, including outstanding liabilities, is \$741,041.21.

The \$85,000 required to complete the present project can be profitably expended during the fiscal year ending June 30, 1891.

July 1, 1888, amount available.....	\$44,873.40
Amount appropriated by act of August 11, 1888.....	90,000.00

134,873.40

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$5,734.61
July 1, 1889, outstanding liabilities.....	180.00

5,914.61

July 1, 1889, balance available.....	128,958.79
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{ Amount (estimated) required for completion of existing project.....	85,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	85,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix Q Q 5.)

6. *San Diego Harbor, California.*—The project for this improvement was made in 1875, and the work was completed in 1876, the object being to prevent the filling up of the harbor by material brought down by the San Diego River during flood stages. The work consisted in changing the course of the river, causing it to empty into False Bay, by excavating a new water-way and building a levee across the old channel near its entrance to the harbor.

Operations since the above date have been simply with a view of keeping the levee in good condition.

A small force was employed last year in this work.

The amount asked for is to make such repairs as may be needed.

The amount appropriated since 1875 is \$82,000, and the amount expended is \$81,918.45.

July 1, 1888, amount available.....	\$41.91
Amount appropriated by act of August 11, 1888.....	1,000.00

1,041.91

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	960.36
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July 1, 1889, balance available.....	81.55
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{ Amount that can be profitably expended in fiscal year ending June 30, 1891	500.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix Q Q 6.)

7. *Survey of San Francisco Harbor, San Pablo and Suisun Bays, Straits of Carquinez, and mouths of San Joaquin and Sacramento rivers, California, officer in charge, Col. G. H. Mendell, Corps of Engineers, until March 21, 1889.*—These surveys were commenced in 1887 with the appropriation of \$11,000 made by the river and harbor act of August 5, 1886. An area of 110.5 square miles in the bay of San Francisco was surveyed, and the maps thereof completed. There yet remains to be surveyed the western half of the bay, including the entrance.

The estimate presented herewith is intended to extend the survey over the entrance.

July 1, 1888, amount available	\$2, 014. 85
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	568. 34
July 1, 1889, balance available	1, 446. 51
<hr/>	
{ Amount (estimated) required for completion of existing project.....	14, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	14, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix Q Q 7.)	

**EXAMINATIONS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS
OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.**

The required preliminary examinations of the following localities were made by the local engineer in charge, Major Benyaund, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers, concurring in the conclusions reached in these instances, has given no instructions to make further survey with the view to their improvement:

1. *San Buenaventura Harbor, California.*—(See Appendix Q Q 8.)
2. *San Simeon Bay, California.*—(See Appendix Q Q 9.)
3. *Colorado River between Camp Mojave and the point where the boundary line between Nevada and Utah Territory intersects said river, including the river between Camp Mojave and El Dorado Cañon, Arizona.*—(See Appendix Q Q 10.)

**IMPROVEMENT OF ENTRANCE TO HUMBOLDT BAY; OF SAN JOAQUIN,
MOKELUMNE, SACRAMENTO, AND FEATHER RIVERS, AND PETA-
LUMA CREEK, CALIFORNIA.**

Officer in charge, Maj. W. H. Heuer, Corps of Engineers. Division Engineer, Col. G. H. Mendell, Corps of Engineers.

1. *San Joaquin River, Stockton and Mormon Sloughs, California.*—The project adopted in 1877 and slightly modified in 1881 had for its object to secure and maintain a channel 9 feet deep and 100 feet wide to Stockton, 4 feet deep and 80 feet wide to Miller's warehouse in Mormon Slough, to straighten the river by cut-offs below the mouth of Stockton Slough, and to temporarily improve the low-water channel of the Upper San Joaquin by the removal of snags, scraping bars, and the construction of wing-dams. Before work was commenced the channel to Stockton had at low-water stage a depth of only 6 feet. The upper river was navigable to Hill's Ferry for boats drawing 2 feet or less for 6 or 7 months in the year.

There has been expended to June 30, 1889, on the river and sloughs, \$173,034.12. During the past year \$15,079.76 was expended in dredging Stockton Slough and building a submerged dam at Paradise Cut, the latter was done by contract at a cost to the United States of \$5,600. From the Stockton Slough 82,150 cubic yards of material was dredged by the United States dredge and put on shore, leaving a good channel 9 feet deep throughout the length and breadth of the slough. At Paradise Cut the dam built was 255 feet long and its crest was 8 feet above low-water level of the San Joaquin River. The water poured over the dam to a depth of 44 inches for several months, and in June, 1889, as one flank of the dam became undermined, it became necessary to cut away about 30 feet of the dam where built in stiff clay in order

to save the balance of the structure. Repairs will have to be made here during the coming autumn when the river is at its lowest stage.

A dam is also required to close a crevasse at Laird's Slough; the estimated cost of this dam is \$9,570. The amount of money appropriated in 1888 was insufficient to warrant the building of this structure. The dredging and other work done in the river has been very beneficial to navigation, though the rates of freight and insurance have not been materially reduced in consequence of the improvement. Where cut-offs have been made they have proved of great advantage and have been self-maintaining. With any future appropriations it is proposed to continue work on the adopted project in the following order unless otherwise directed by Congress, and depending on amounts appropriated:

1. Dredging to maintain 9 feet depth to Stockton.
2. Repairs to Paradise Cut Dam.
3. Closing crevasse at Laird's Slough.
4. Snagging, scraping, or building low wing-dams in Upper River.
5. Making new cut-off at Twenty-one Mile Slough or Head Reach.

Estimated amount that can be profitably expended in the fiscal year ending June 30, 1891, \$50,000.

July 1, 1888, amount available.....	\$795. 64
Amount appropriated by act of August 11, 1888.....	25, 000. 00
	<hr/>
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	25, 795. 64
	15, 079. 76
	<hr/>
July 1, 1889, balance available.....	10, 715. 88
	<hr/>
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	50, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix R R 1.)

2. *Mokelumne River, California.*—The project was adopted in 1884; its object was the removal of snags and overhanging trees which obstructed navigation between the mouth of the river and Benson's Ferry. Both forks of the river were cleaned out to the head of navigation at a cost of \$10,960.58.

Appropriations have been made at various times for the improvement of this river amounting to \$13,000.

During the past year the snag-boat *Seizer* worked in this river from December 1 to December 18, 1888, and removed snags, overhanging trees, and cleared the brush from the banks. Snags will continue to lodge in the narrow channel, and occasional work by the snag-boat will be necessary. It is believed that no additional money will be necessary for the fiscal year ending June 30, 1891.

The project as made has been completed; it has enabled boats to get to Benson's Ferry and made 10 or 12 miles of river, which was dangerous to navigate, perfectly safe. Steamboats make regular trips. It is not known that freight or insurance rates have been reduced in consequence of the improvement.

July 1, 1888, amount available.....	\$39. 42
Amount appropriated by act of August 11, 1888.....	2, 000. 00
	<hr/>
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	2, 039. 42
	1, 479. 19
	<hr/>
July 1, 1889, balance available.....	

(See Appendix R R 2.)

3. *Sacramento and Feather rivers, California.*—The project was made in 1874 and had for its object the improvement of the low-water channel by wing-dams, bar scraping, and the removal of snags and trees. Up to June 30, 1889, there has been expended for this purpose \$342,632.01, which includes the construction of a dredge, snag-boat, and two barges. Thus far Congress has appropriated for these streams \$465,000, but by act of July, 1884, prohibited the expenditure of \$100,000 of these funds until the Secretary of War should be satisfied that hydraulic mining had been stopped, and \$13,890.03 additional have been reserved for legal expenses in the suppression of hydraulic mining.

Before improvement began, in 1875, the Upper Sacramento River was much obstructed by snags, navigation was dangerous, and freight and insurance rates were very high. Snags accumulated annually; at first they were removed by contract, afterwards by our own snag-boat and hired labor at less than half the cost heretofore paid. Railroads were built upon both sides of the river; thereafter and after the removal of the snags, freight rates were reduced fully one-half and navigation was rendered perfectly safe. It is not assumed that the improvement of the river alone produced the reduction in freight rates and insurance. Competition with the railroads was an important factor in this reduction, but had the snags not been removed, navigation would have been impracticable, and in all probability these rates would have been increased instead of being reduced. The last appropriation of \$20,000 for continuing the improvement was so worded that it could only be used for dredging and snagging work. This was unfortunate, as dredging in these rivers is only of temporary benefit to the low-water channel, and better results are produced by wing-dams at less cost and in less time; but as no funds could be used for wing-dams, only snagging operations could advantageously be applied during the past fiscal year.

The snag-boat worked about ten weeks in 1888 and removed all the troublesome snags in the river, and thus permitted navigation to go on uninterruptedly. She also repaired a wing-dam near the city of Sacramento. The transportation company furnished the material (old barges) with which the repairs were made. The snag-boat now needs extensive repairs, estimated to cost about \$8,000, and until these repairs are made will be unfitted for further service. She is again in commission, and must complete the work for this summer on which she is now engaged, which will probably exhaust all the funds available. The legislature of the State of California, in March, 1889, empowered the governor to appoint three engineers as an examining commission on rivers and harbors in California. The legislative act referred to says the commission shall determine what steps are necessary for the rectification and improvement of such rivers and streams, and shall make, or cause to be made, such surveys, examinations, maps, designs, drawings, estimates, specifications, etc., as will enable Congress to clearly understand the condition of such rivers and the cost and expense of properly rectifying the same. Reference to printed annual reports since 1874 shows what is necessary to improve and maintain the low-water navigation of these rivers, and the improvement and maintenance of low-water navigation is all that the Government engineers have attempted, of which Congress has been fully informed and for which funds have been appropriated and judiciously expended. Snags will re-form and will have to be removed annually, hence no final estimate for the completion of the work can be made with any degree of accuracy.

For the fiscal year ending June 30, 1891, \$48,000 can be expended to good advantage in snagging and building low wing-dams,

July 1, 1888, amount available	\$115, 387. 13
Amount appropriated by act of August 11, 1888	20, 000. 00
	<hr/> 135, 387. 13

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$11, 635. 66
July 1, 1889, outstanding liabilities	1, 383. 48
	<hr/> 13, 019. 14

July 1, 1889, balance available	122, 367. 99
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{ Amount that can be profitably expended in fiscal year ending June 30, 1891	44, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix R R 3.)

4. *Petaluma Creek, California.*—The project adopted in 1880 had for its object to straighten the channel by cut-offs and secure, by dredging for about 8,000 feet below Petaluma, a channel 50 feet wide and 3 feet deep at low water. Before improvement the channel was very crooked and bare at low water. Work was completed in 1884, at a cost of \$27,656.91, leaving a balance available of \$2,343.09.

In the spring of 1888 the channel had refilled to such an extent that the bottom of the creek was in places at low water 2 feet above low-tide level, and vessels could only enter the creek at high tide. In June, 1888, with the small balance available, dredging was done by contract, and in July the work was completed by removing about 8,000 cubic yards of material from the channel and depositing it on the banks. A channel 1,800 feet long, 50 feet wide, and 1 foot deep at lowest low water was obtained, thus relieving the immediate wants of the navigation interests. The cost of the dredging was \$2,116.39.

The channel thus formed can only be maintained by occasional dredging. The commerce of the creek is sufficient to warrant a channel 4 or 5 feet deep, and to get this depth the estimated cost is \$30,000. The work can be done in one year, and once done it is believed that the channel can be maintained in reasonably good condition by dredging once in five years at a cost of say \$5,000.

July 1, 1888, amount available	\$16. 46
Amount appropriated by act of August 11, 1888	2, 000. 00

July 1, 1889, balance available	2, 016. 46
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{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix R R 4.)

5. *Humboldt Harbor and Bay, California.*—The project for the improvement of the bay was adopted in 1881. Its object was to obtain by dredging a channel 13 feet deep and 200 feet wide, to the upper end of the wharves in Eureka, and to dredge channels 10 feet deep and 100 feet wide to Arcata and Hookton. The project was completed in 1884. It has since deteriorated. In 1882 a project was submitted and adopted to improve the entrance to Humboldt Bay by building a training-wall to the level of low water, extending from the South Spit in a northwesterly direction. The estimated cost of the training-wall was \$600,000. Before improvement the channel to Eureka had a depth of 7 feet; those to Arcata and Hookton had depths of 6 feet.

During the past year proposals for building the training-wall and necessary shore protection were invited, and the contract for doing the work was awarded to the American Bridge and Building Company of

San Francisco, the lowest bidders, at the following rates: Rock, \$2.00 per ton; brush-work, \$1.85 per cubic yard; for pier and track over water, per linear foot, \$5.50; for railroad and track on shore, per running foot, \$2.75. In May, 1889, they began building the walls, and in two months at the end of the year had completed 1,605 feet of shore-track and 999 feet of pier over water, had completed 1,152 running feet of shore-protection wall composed of brush and stone, the brush-work varying from 15 to 22 feet in width and from 18 to 26 inches in height, the rock-work on top of this 15 to 20 feet wide and 4 feet high in the center. In the water (between high and low water) the brush-work varies from 22 to 36 feet wide, 26 to 33 inches high, which is covered with rock for its entire length; the average height of completed wall (272 feet long) is 4 feet. Thus far 6,206 tons of rock and 3,303 cubic yards of brush have been placed in position. The contract with the American Bridge Company is for \$250,000 worth of work at above rates, and they are required to complete their work on December 31, 1889, at which time about all the funds available will be exhausted. As the work of improving the bar channel has but just commenced, no results in the way of improvement have been obtained or expected. To make a success of the work this submerged training wall should be pushed to completion as rapidly as possible. When this is done it may become necessary to increase its height, and in addition, walls to prevent erosion may become necessary on the North Spit. No estimate has yet been made for additional work, but should it become necessary, the cost will be at least as great as that of the submerged training wall now in course of construction. The total amount expended on the improvement of Humboldt Bay to June 30, 1889, has been \$96,061.55.

July 1, 1888, amount available	\$136, 615. 31
Amount appropriated by act of August 11, 1888	125, 000. 00
	<hr/>
	261, 615. 31
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$15, 176. 86
July 1, 1889, amount covered by existing contracts.....	239, 618. 96
	<hr/>
	254, 795. 82
July 1, 1889, balance available	6, 819. 49
	<hr/>
{ Amount (estimated) required for completion of existing project.....	337, 500. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	200, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix R R 5.)	

EXAMINATIONS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examinations of the following localities were made by the local engineer in charge, Major Heuer, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers, concurring in the conclusions reached in these instances, has given no instructions to make further survey with a view to their improvement:

1. *El River, California, entrance and inside bars to head of navigation.*—(See Appendix R R 6.)
2. *Klamath River, California, entrance and inside bars to head of navigation.*—(See Appendix R R 7.)

3. As to the necessity for the establishment and maintenance of public moorings for the protection of shipping in the open and exposed ports on the northern coast of California at Fort Ross, Fisk's Mill, Fish Rock, Shelter Cove, Trinidad, etc.—(See Appendix R R 8.)

IMPROVEMENT OF THE ENTRANCE TO COOS BAY—IMPROVEMENT OF YAQUINA BAY, OF COQUILLE RIVER, OF UMPQUA RIVER, AND OF TILLAMOOK BAY AND BAR, OREGON.

Officer in charge, Capt. Willard Young, Corps of Engineers. Division Engineer, Col. G. H. Mendell, Corps of Engineers.

1. *Coquille River, Oregon.*—At the time the work of improvement was begun, the entrance to the Coquille River was considered very dangerous. It was by a long, tortuous, and narrow channel skirting the south headland, studded with rocks from beyond the bar on the outside to a distance of one-half mile inside. The depth at low water over the bar was only about 3 feet; and the position of the channel was constantly shifting. The channel sometimes, at long intervals apart, broke through the north spit and ran directly out to sea, just south of Rackliffe Rock, but did not remain long in this position. The entrance at such times was comparatively safe, and the channel was at its very best. The mean rise of tide was 4.1 feet.

The plan of the improvement is to construct two parallel, high-tide stone jetties, 800 feet apart, running out to sea a sufficient distance to open and maintain a channel over the bar, with a least depth of 8 feet at low water; the north jetty starting from Rackliffe Rock, and the south jetty from a point on the left bank inside the entrance.

The amount expended to June 30, 1888, including outstanding liabilities, was \$49,510.43; 1,926 feet of temporary jetty had then been constructed. The channel through the north spit was opened in 1882, after the construction of about 1,000 feet of temporary jetty, since which time a depth of 6 feet at low water has been maintained.

During the year ending June 30, 1889, 4,000 cubic yards of stone was quarried and placed in the jetty, and an additional 3,000 cubic yards of stone was blasted out ready for use; 1,994 feet of tramway was built; one powerful derrick was erected; one locomotive, irons for two derricks, and rails, spikes, fish plates, switches, etc., for 3,025 feet of track were purchased.

Other operations consisted in the storage and care of property.

The depth of water on the bar during the year has been 6 feet or more at low water. During the months of January, February, and March a depth of 20 feet at high water was maintained. This was due to the fact that the north spit extended out the whole length of the jetty and parallel to it, at a distance of only about 300 feet, thus acting as a low north jetty, which, with the south jetty, confined the water in one narrow channel.

The appropriations made in five acts amount to \$75,000.

July 1, 1888, amount available	\$489.57
Amount appropriated by act of August 11, 1888.....	25,000.00
	<hr/> 25,489.57
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$18,312.24
July 1, 1889, outstanding liabilities, about.....	2,525.55
	<hr/> 20,837.79
July 1, 1889, balance available.....	<hr/> 4,651.78

{ Amount (estimated) required for completion of existing project..... \$24, 000. 00
 { Amount that can be profitably expended in fiscal year ending June 30, 1891 50, 000. 00
 { Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix S S 1.)

2. *Entrance to Coos Bay and Harbor, Oregon.*—The obstructions which existed at the entrance to this harbor before the works of improvement were begun, consisted, first, of the outer bar, which is of sand, and is shifting in character; and, secondly, of the inner shoals, formed by the sands which accumulate in the spring, summer, and autumn during the times when the northwesterly winds prevail. Under the action of these winds the spit on the north side advanced toward the south, contracting the navigable passage under Coos Head to a very narrow width, and, usually, making the outer channel follow the west side of the spit in a long and tortuous course across the bar. The channel had at times broken through the north spit on a line, the general direction of which is from Fossil Point to a point just to the north of Coos Head. It was then direct, the depth of water was greatest, and vessels could enter or go out without trouble.

The mean rise of tide above the plane of reference was 5.6 feet. The project for this improvement, adopted in 1879, is to construct, at an estimated cost of \$600,000, a jetty of wood and stone, or of stone, as may be found best, from a point 250 yards below the northern extremity of Fossil Point, on a line towards the east end of Coos Head, this line in plan curving so as to be directed at its outer end to the head or a little to the north of it.

The object is to prevent accretion to the south end of the sand spit on the north side of the entrance, and to open and maintain a deeper and more direct channel across the outer bar.

A Board of officers of the Corps of Engineers now has under consideration the project for the improvement of Coos Bay. (See preliminary report of the Board hereto attached, Appendix S S 2.) Their final report will probably be submitted some time in August next.

The amount expended to June 30, 1888, including outstanding liabilities, was \$134,529.10. The jetty had then been partly built to a length of 1,761 feet, and had caused a partial erosion of the end of the north spit, and a corresponding fill at the mouth of South Slough, and had opened a channel over the outer bar well to the south, which was deeper, wider, and less exposed to wind and sea than the former channel in its usual position. The new channel is also much less shifting than the old one.

Active operations in jetty building were resumed May 1, 1889, since which time 3,314 cubic yards of stone has been placed in advance of the jetty as a foundation course to keep the bottom of the channel from scouring out as the jetty is extended. The stone is delivered in place from self-dumping barges, so that a load of about 200 yards can be deposited in a few minutes. The work is being done by contract. A careful survey of the bay in the vicinity of the jetty was made, and borings were taken across the north spit to furnish data required by the Board of Engineer Officers appointed to consider and report upon a project for the improvement at Coos Bay.

It is expected that the jetty will be extended, and that its top throughout will be raised to 2 feet above low water. The first work to be done is to lay a proper foundation course of stone on the line of the proposed extension. This is needed to prevent the bottom from scouring out, and so to keep the cross-section of the jetty as small as possible.

The average depth of water over the proposed extension is about 60 feet, so that most, if not all, of the stone needed for the extension can be dumped from scows.

The appropriations made in six acts amount to \$213,750.

July 1, 1888, amount available.....	\$29,220.90
Amount appropriated by act of August 11, 1888.....	50,000.00
	<hr/> 79,220.90

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$6,257.87
July 1, 1889, outstanding liabilities.....	3,289.23
July 1, 1889, amount covered by existing contracts.....	62,574.18
	<hr/> 72,121.28
July 1, 1889, balance available.....	<hr/> 7,099.62

(Amount (estimated) required for completion of existing project.....	386,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1891.....	250,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix S S 2.)

3. *Umpqua River, Oregon.*—Just below Scottsburgh, the head of navigation on the Umpqua River, are five sandstone bars or ledges 12 feet to 15 feet wide and submerged from 1 foot to 2 feet at low tide on a low river stage. They are separated by pools about 150 feet wide and from 5 to 10 feet deep at low water.

The project is to deepen the water over these ledges to 3 feet at low water through a channel 50 feet wide.

The amount expended on the project to June 30, 1888, including outstanding liabilities, was \$4,675.14, and resulted in increasing the controlling depths over the reefs, through a channel 50 feet wide, from 1 foot at low water, which formerly existed, to 2 feet at low water.

No work whatever was done during the past year. The money appropriated for this work August 11, 1888, was not available until after the favorable season of low, clear water had passed, so it was thought advisable to postpone the work until the next favorable season, which will be in July and August.

It was estimated at the time work was suspended in August, 1886, that \$2,000 would be required to complete the present project. This amount was appropriated August 11, 1888. Work under this appropriation will be resumed early in July, and will consist as heretofore in drilling and blasting the rock ledges and removing the broken pieces to deeper water from the 50-foot channel. No work under the existing project is contemplated after the exhaustion of the funds now available.

Appropriations have been made for this improvement amounting to \$24,500.

July 1, 1888, amount available.....	\$10.75
Amount appropriated by act of August 11, 1888.....	2,000.00
	<hr/> 2,010.75

(See Appendix S S 3.)

4. *Yaquina Bay, Oregon.*—The usual prevailing depths over the bar at low water, before improvement, were from 7 feet to 8 feet. Three distinct channels existed, known as the North, Middle, and South Channels. The South Channel was the one most used, but was rendered dangerous by the presence of rocks. The Middle Channel, though free from rocks,

was usually the shoalest of the three and so was little used. The North Channel, besides being long and tortuous, was so studded with rocks as to be considered unnavigable. Owing to the shifting nature of the bar, these channels were constantly changing both in position and in depth.

The mean rise of the tide was 7.1 feet.

The project adopted in 1881 was to run out a dike or jetty on the south side of the entrance, so as to cause the South Channel to shoal up and the flow to be deflected northward, with a view to opening and maintaining the Central Channel with a least depth of 17 feet at high water.

The present project, adopted in 1888 (see report of Board of Engineer Officers hereto attached), is to raise the south jetty to full high water without extending it seaward, thus making its total length 3,748 feet, and to construct a mid-tide jetty on the north side of the entrance, about 2,300 feet in length, extending from the North Head, along and behind the reef putting out from the Head, to a point opposite the end of the south jetty, and distant from it about 1,000 feet.

The amount expended to June 30, 1888, including outstanding liabilities, was \$234,333.00. At that date 2,977 feet of jetty and 450 feet of dike had been constructed, but not completed to full height and strength. The 450 feet of dike, built as a shore protection, was practically destroyed by the action of the sea during the year 1888. The jetty, however, remained intact.

The South Channel had been permanently deflected from the south rocks and made to unite with the Central Channel. The prevailing depths over the bar were greater by 3 or 4 feet, and the channel was less shifting and much safer than formerly.

During the year ending June 30, 1889, \$98,453.66 was expended in making additions to the plant, in raising the south jetty and extending it shoreward, in work on the north jetty, and in making a hydrographic survey of the bar and entrance.

This survey shows the present condition of the bar to be the best on record, there being 14 feet at mean lower low water, with the channel running straight out nearly parallel with the south jetty.

The money asked for, if appropriated, will be used in the construction of the north jetty. It is expected that the concentration of the water into one narrow channel, which will result from the construction of the north jetty, will insure a considerable increase of depth over the bar.

It is expected that the south jetty will be entirely completed this season, and that the north jetty will be partly completed for a length of about 1,000 feet.

Appropriations have been made for this improvement amounting to \$385,000.

July 1, 1888, amount available	\$666.91
Amount appropriated by act of August 11, 1888.....	150,000.00
	<hr/> 150,666.91
July 1, 1889, amount expended during fiscal year, exclusive of	
liabilities outstanding July 1, 1888.....	\$98,298.16
July 1, 1889, outstanding liabilities, about.....	9,000.00
	<hr/> 107,298.16
July 1, 1889, balance available	43,368.75

{ Amount (estimated) required for completion of existing project.....	\$75,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	75,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix S S 4.)

5. *Tillamook Bay and Bar, Oregon.*—The channel over the bar is direct, and shifts but little, so that the bar is considered one of the safest on the Oregon coast. A fair depth of water is maintained throughout most of the year, and vessels drawing as much as 13 feet can usually enter without difficulty.

The bay at low tide consists of three channels running through vast sand and mud flats. These channels are of fair depth near the entrance, but gradually shoal up, giving depths of only 1 or 2 feet, near the head of the bay. Tillamook, the principal town of the region, is situated on a tidal slough above the head of the bay, and can be reached only by light draught vessels at high tide.

The project for the expenditure of the money appropriated by the act of August 11, 1888, is to make a survey of the bar and entrance, so that a general project for the improvement of the bay and bar may be studied; to deepen the water over Dry Stocking Bar at the mouth of Hoquarton Slough, on which Tillamook City is situated, by constructing longitudinal and spur dikes and shore-protection works, and to cut down overhanging trees, and do snagging work along Hoquarton Slough, as far up as Tillamook City.

Active operations for the carrying out of this project will be begun early in July.

There are large bodies of the finest kind of timber on and tributary to the bay. It is therefore probable that the lumbering interests which will grow out of this will demand an improvement, both of the bar and of the channels in the bay. At present the demand is for a better channel from the Lower Bay to Tillamook City.

The act of August 11, 1888, appropriated \$5,200 for this improvement.

Amount appropriated by act of August 11, 1888	\$5,200.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$47.78
July 1, 1889, outstanding liabilities	68.81
July 1, 1889, amount covered by existing contracts	3,600.00
	<hr/>
	3,716.59

July 1, 1889, balance available	1,483.41
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(See Appendix S S 5.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examinations of the following localities were made by the local engineer in charge, Captain Young, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers concurring in the conclusions reached in these instances, has given no instructions to make further survey with the view to their improvement.

1. *Clackamas River, Oregon.*—(See Appendix S S 6.)
2. *Tualatin River, Oregon.*—(See Appendix S S 7.)
3. *Umpqua River between Scottsburg and Hart's Rapids, near Elkton, Oregon.*—(See Appendix S S 8.)

It appearing from the report of the preliminary examination made by the local engineer that the following localities are worthy of improve-

ment, and the public necessity therefor being apparent from the facts and reasons reported, which are concurred in by the Chief of Engineers, Captain Young was charged with their survey, the results of which will be submitted when received:

1. *Siuslaw River and Bar, Oregon.*
2. *Nehalem Bay and Bar, Oregon.*
3. *Young's River and its tributary, Klaskuine River, Oregon.*
4. *Umpqua River, Oregon, between Scottsburgh and the mouth.*

IMPROVEMENT OF THE MOUTH OF THE COLUMBIA RIVER, OREGON AND WASHINGTON TERRITORY—CONSTRUCTION OF CASCADES CANAL, COLUMBIA RIVER—IMPROVEMENT OF THE CHEHALIS RIVER; OF THE SKAGIT, STEILAQUAMISH, NOOTSACK, SNOHOMISH, AND SNOQUALMIE RIVERS, WASHINGTON TERRITORY—WATER-GAUGES ON COLUMBIA RIVER.

Officer in charge, Maj. Thomas H. Handbury, Corps of Engineers, having under his immediate orders Lieut. Edward Burr, Corps of Engineers. Division Engineer, Col. G. H. Mendell, Corps of Engineers.

1. *Mouth of the Columbia River, Oregon and Washington Territory.*—The project under which this work is being carried on was adopted in 1884. It contemplates providing a channel across the Columbia River Bar, having a depth of 30 feet at mean low tide. This is to be effected by concentrating the water flowing over the bar and increasing the resultant currents to such a degree as to procure the desired depth. Any work for accomplishing this end must be more or less tentative in its character. The work which is now in progress is the building of a low-tide jetty, starting from Fort Stevens, on the South Cape, and extending in a westerly direction, with a slight curve to the south, out across Clatsop Spit, for a distance of $4\frac{1}{2}$ miles, more or less, as circumstances may require, to a point about 3 miles south of Cape Hancock (Disappointment). This jetty is constructed of stone, resting upon a mattress foundation about 40 feet wide and from $2\frac{1}{2}$ to 5 feet thick. The stone extends to the level of the mean lower low water. The materials thus far have been placed in position from a jetty tramway, supported upon piles driven along the line of the jetty, and about 24 feet above the level of low tide. This tramway is a double track, 3-foot gauge railroad, the tracks being 13 feet between centers. The materials are landed at the wharf and transported to place over these tracks, which are built in advance of the main work.

Everything connected with the work is now in active operation, and the plant is being pushed to its full capacity, thus working in the most economical manner. On this basis the funds now available will be substantially exhausted, so far as actual progress is concerned, about 1st of December next, which may be called the end of the working season. It is extremely desirable that by that time additional funds should be made available for carrying on the work. The plant now provided is extensive and in thorough working order. It would be in the interests of economy to keep this continually employed to its full capacity until the project is completed. As the work progresses the jetty tramway becomes more greatly exposed to the action of the sea, and is more liable to be destroyed or damaged during violent storms. To replace this when the jetty is partially built would be difficult and expensive. It is advisable on this account also to push the work forward as rapidly as possible. Of late years the main bar channel has varied in depth from 19 to 21 feet at low water; 26 feet are required in a wide, direct,

and stable channel, and 30 feet are desirable for the deep vessels needed by the Columbia River trade.

The jetty proper is now under construction for a little more than 1½ miles. Rock has been dumped to the height of mean low water, over an average of about 1 mile of this distance. It is expected that by the end of the present working season, which will be about the 1st of December, the jetty tramway will be advanced about one-half mile further.

Within the last year a marked change has taken place on Clatsop Spit and in the channel over the Columbia River Bar. The Spit shows decidedly more bare surface at low water than formerly, and the channel of the river has a decided tendency towards a straight course out to sea. Tillamook Chute, where there were indications that a new channel was being cut southward across Clatsop Spit when the work was commenced, is now being closed, although the jetty-work is not yet within one-half mile of it. It is observed that as the mattress-work is carried out the sand-spit builds up on the south side abreast of and sometimes ahead of it. At extreme low water one can walk on the sand out as far as the mattress work extends. The indications now are that the work has progressed to such a point that it is having a manifest influence upon the natural forces at work in the vicinity, and that these forces are bringing about the result desired.

The amount appropriated for this work is \$787,500. The amount expended to the end of the present fiscal year is \$614,252.92, leaving a balance of \$173,247.08 yet applicable to the further prosecution of the work. This amount will be practically exhausted about the 1st of December next.

July 1, 1888, amount available.....	\$40,246.25
Amount appropriated by act of August 11, 1888.....	500,000.00
	<hr/> 540,246.25

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$280,342.86
July 1, 1889, outstanding liabilities.....	3,798.26
July 1, 1889, amount covered by existing contracts.....	82,858.05
	<hr/> 366,999.17
July 1, 1889, balance available.....	<hr/> 173,247.08

Amount (estimated) required for completion of existing project.....	2,423,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1891.....	700,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

• (See Appendix T T 1.)

2. *Construction of canal at the Cascades, Columbia River, Oregon.*—The general scope of the improvement which it is desired to effect at the Cascades of the Columbia River includes a reach of about 4½ miles. The principal obstruction to navigation occurs at the upper end of this reach at what is known as the Upper Cascades.

The project contemplates that the river should be improved below the Upper Cascades by removing bowlders and projecting points in the bed and banks, so as to give good navigable water from its lowest up to a 20-foot stage. The falls at the Upper Cascades is to be overcome by digging a canal about 3,000 feet in length across the neck of a low projecting spur and placing in this a lock and suitable other structures, which will permit of the passage of boats up to a 20 foot stage of water in the river; this lock to be so arranged that additional structures may

be made, which will permit navigation at higher stages. So far as is contemplated for the present, the first part of the project is completed.

The principal work done during the year was excavation in the lock-pit and foundation for the masonry of the lower gates, which was practically finished; also excavation in the lower tail bay, cutting granite and basaltic dimension stones for this masonry, and laying up the dry stone side-walls of the lower tail bay.

The amount appropriated for this work is \$1,442,500, of which sum \$1,361,987.66 has been expended, including amounts covered by existing contracts, leaving at the end of the present fiscal year \$80,512.33 available for the further prosecution of the work. With this it is proposed to continue the cutting of the stones for the masonry of the lower gates and to commence at once the construction of this masonry now that the foundation is prepared. The construction of the lower bay side-walls will be continued. The construction of the masonry of the lower gates will be pushed forward as rapidly as practicable and as available funds will permit, with the view to placing against this a temporary bulkhead, which will keep river-water out of the lock-pit to a higher stage than the present arrangement admits of, in that advantage can be taken of a longer and better season for carrying on the work.

The amount now available will be practically exhausted in these operations about the end of November next. In order that the work may be economically continued and the time hastened when some return can be had for the large amount of money already expended on this project, and to avoid the expense which is a necessary incident to every suspension of operations, additional funds should be made available at the earliest practicable moment.

July 1, 1888, amount available.....	\$2, 347.59
Amount appropriated by act of August 11, 1888.....	300, 000.00
	<hr/> 302, 347.59
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$200, 555.38
July 1, 1889, amount covered by existing contracts.....	21, 279.88
	<hr/> 221, 835.26
July 1, 1889, balance available.....	<hr/> 80, 512.33
{ Amount (estimated) required for completion of existing project.....	1, 250, 000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	700, 000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix T T 2.)

3. *Chehalis River, Washington Territory.*—The project for the improvement of this river consists in removing logs, snags, and other obstructions from its bed and banks, so as to provide a navigable channel-way during its medium and higher stages for steam-boats from Claquato to its mouth in Gray's Harbor. This distance is between 80 and 100 miles. Montesano, 12 miles from its mouth, is the head of coasting navigation. Eighteen feet at high water can be carried to this point. The head of tide-water is at Elma, 16 miles above Montesano. Between these points navigation is obstructed by snags and fallen trees, by the removal of which a good all-the-year-round channel can be provided from Elma to the mouth. Above Elma the river is practically blockaded during the summer and fall by snags, shoals, and principally a want of water. At this time the river-bed is a succession of shoals and pools; the depth of water on many of the shoals is reported to be

but from 6 to 12 inches. No attempt has been made to improve these shoals.

A light-draught vessel with crew was hired for this work last fall and operated about two weeks between Elma and the mouth of the river. Rains set in, the river rose, and work had to be discontinued. Since that time the water has not fallen to a good snagging stage. Sixty snags and five overhanging trees were removed. The work will be resumed early this fall, and continued until the small balance of the appropriation is exhausted.

The amount appropriated for this work is \$10,000, of which \$8,667.14 has been expended. It is estimated that \$3,000 could be profitably expended during the fiscal year ending June 30, 1891.

July 1, 1888, amount available.....	\$39. 17
Amount appropriated by act of August 11, 1888.....	2, 000. 00

2, 039. 17

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	706. 31
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July 1, 1889, balance available.....	1, 332. 86
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{ Amount that can be profitably expended in fiscal year ending June 30, 1891	3, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix T T 3.)

4. *Skagit, Steilaquamish, Nootsack, Snohomish, and Snoqualmie rivers, Washington Territory.*—The project for the improvement of these rivers contemplates the removal of logs, snags, trees, and other obstructions to their navigation. There is provided for this purpose a snag-boat, with an outfit of tools and appliances, which passes from one river to the other, doing service in each as far as the necessities of commerce require and the funds appropriated will admit.

The aggregate navigable length of the rivers is about 250 miles. During the year 1,527 snags and 449 overhanging trees were removed. A cabin was placed upon the boat for the better accommodation of the crew, the capstan machinery was overhauled and put in order, and sundry needed articles of outfit supplied. The boat was in service from October 1, 1888, to May 10, 1889. At this latter date the funds available for snagging operations being practically exhausted, the boat was laid up in ordinary in charge of a watchman.

Fifty-seven thousand five hundred dollars have been appropriated for the improvement of these rivers.

July 1, 1888, amount available.....	\$101. 33
Amount appropriated by act of August 11, 1888.....	15, 000. 00

15, 101. 33

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	10, 983. 43
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July 1, 1889, balance available.....	4, 117. 90
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{ Amount that can be profitably expended in fiscal year ending June 30, 1891	12, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix T T 4.)

5. *Gauging waters of the Columbia River, Oregon.*—The object of these gaugings is to ascertain and keep a record of the fluctuations of the Columbia River with the view to gathering information that may be useful in works of improvement on the river, and also by gauges es-

tablished at various points to indicate to pilots, captains, and those interested in navigation, the stage of water on crossings and places of difficult navigation.

On the 1st of November the automatic self-registering tide-gauge was re-established in Astoria, Oregon; since that time it has been continually in operation. Daily sheets are exhibited on a bulletin board in Astoria which indicate to pilots and others interested in the condition of the bar at the mouth of the Columbia River the stage of water and the degree of roughness on the bar. These are of great service to commerce.

Amount appropriated by act of August 11, 1888.....	\$2, 500. 00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	414. 83
July 1, 1889, balance available.....	<u>2, 085. 17</u>
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	2, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	
(See Appendix T T 5.)	

IMPROVEMENT OF COLUMBIA AND WILLAMETTE RIVERS BELOW PORTLAND, OREGON; OF UPPER WILLAMETTE, UPPER COLUMBIA, AND SNAKE, AND COWLITZ RIVERS, OREGON AND WASHINGTON TERRITORY.

Officer in charge, Maj. W. A. Jones, Corps of Engineers; Division Engineer, Col. G. H. Mendell, Corps of Engineers. These works were in temporary charge of Capt. Williard Young, Corps of Engineers, from June 20, 1888, to September 11, 1888, inclusive.

1. *Columbia and Lower Willamette rivers below Portland, Oregon.*—The project for this improvement was adopted in 1877, and modified subsequently, the object being to afford a ship-channel of 20 feet depth at low water by contraction and shore protection works at four bars between Portland and Columbia City, Oregon; by temporary improvement at the bars during construction of the works; by temporary improvement at three shoal places below Columbia City, and by snagging operations.

The natural depth of the channel at the shoalest places was about 9 feet, and on six other bars it was from 10½ to 15½ feet at low water.

The amount expended on the project to June 30, 1889, was \$511,132.23, and has resulted in maintaining a channel depth of successively 17, 18, and 19 feet at low water from Astoria over the whole reach of 100 miles.

Operations during the year consisted of extensive repairs to plant and constructions; the construction of 1,026 feet of extension of the jetty at St. Helen's Bar; the closing of Burkes and Martins Island Sloughs by permanent dams; dredging operations at Swan Island Bar and Skamokawa Bar; the survey of all the bars below Portland, and the preparation of plans for their improvement.

The amount asked for the next fiscal year is for continuing the project.

July 1, 1888, amount available.....	\$1,714. 59
Amount appropriated by act of August 11, 1888.....	100,000. 00
	<u>101,714. 59</u>
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$63,234. 25
July 1, 1889, outstanding liabilities.....	857. 00
	<u>64,091. 25</u>
July 1, 1889, balance available	<u>37,623. 34</u>

{ Amount (estimated) required for completion of existing project.....	\$325,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	200,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix U U 1.)

2. *Willamette River, above Portland, Oregon.*—The project for this improvement was adopted in 1878, and extended in later years. The object is to maintain and afford an easy, light-draught navigation from Portland to Eugene City, Oregon, and in 12 miles of tributaries, making in all a distance of 184 miles. The work consists in snagging operations, bar scraping, and for the reach between Willamette Falls and Corvallis, in the contraction of water-way by low cut-off dams, and rock removal. The mouth of the Yamhill, 28 miles above the falls, was the head of an inconvenient low-water navigation in a draught of 2½ feet. Only 1 foot could be carried above.

Total appropriation to date is \$113,000; amount expended, \$108,963.52.

The operations for the year consisted of snagging operations and wing-dam construction with the snag-boat *Corvallis*, assisted by the snag-boat *Willamette*, and construction of revetment at threatened cut-off near Corvallis, Oregon, and surveys.

The amount asked for is to be applied for snagging, bar scraping, wing-dam construction, rock removal, and surveys.

July 1, 1888, amount available	\$3.23
Amount appropriated by act of August 11, 1888	29,000.00
	<hr/> 29,003.23

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$21,005.35
July 1, 1889, outstanding liabilities.....	3,961.40
	<hr/> 24,966.75

July 1, 1889, balance available	4,036.48
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{ Amount that can be profitably expended in fiscal year ending June 30, 1891	22,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix U U 2.)

3. *Upper Columbia and Snake rivers, Oregon and Washington Territory.*—The plan for this improvement adopted in 1877 consists of rock removal at a number of very swift rapids, to give channel depths at low water of 5½ feet on the Columbia, and 4½ feet on the Snake, a river length of 266 miles between Celilo on the Columbia and Lewiston on the Snake. The natural channel was narrow, tortuous, and dangerous, with many very difficult rapids.

The amount appropriated to date is \$131,000. The amount expended to date is \$130,094.62, and has resulted in improvement in many localities.

The operations during the year consisted of rock removal at various points.

It is proposed with the appropriation asked for to continue the work.

Amount appropriated by act of August 11, 1888.....	\$10,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$8,704.39
July 1, 1889, outstanding liabilities.....	390.23
	<hr/> 9,094.62
July 1, 1889, balance available	905.38

Amount required for completion of existing project.....	\$16,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1891	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix U U 3.)

4. *Cowlitz River, Washington Territory.*—The project for this improvement, adopted in 1880, consists in wing-dam construction, bar scraping, and snagging operations, to secure a light-draught navigation up to Toledo, a little more than 30 miles above the mouth of the river.

The original estimate for this work contemplated \$3,000 for construction in the first year and an annual expenditure thereafter of \$2,000 for maintenance by snagging operations.

The total appropriation to date is \$11,000. The amount expended to date is \$11,000.

The operations during the year consisted in channel maintenance, wing-dam construction, and shore protection.

Amount appropriated by act of August 11, 1888.....	\$3,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	3,000.00

Amount required for maintenance of existing project.....	4,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1891	2,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix U U 4.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF THE RIVER AND HARBOR ACT OF AUGUST 11, 1888.

The required preliminary examination of *North Palouse River, Washington Territory*, was made by the local engineer in charge, Major Jones, and reported by him as not worthy of improvement, with facts and reasons for such opinion. The Chief of Engineers concurring in the conclusion reached in this instance, has given no instructions to make further survey with the view to its improvement. (See Appendix U U 5.)

It appearing from the report of the preliminary examination made by the local engineer that *Upper Columbia River, Washington Territory, between Wallula and British line*, is worthy of improvement, and the public necessity therefor being apparent from the facts and reasons reported, which are concurred in by the Chief of Engineers, Major Jones was charged with its survey, the results of which will be submitted when received.

EXAMINATIONS, SURVEYS, AND CONTINGENCIES OF RIVERS AND HARBORS.

For examinations and surveys for improvement, and for contingencies and for incidental repairs of harbors for which there is no special appropriation, an appropriation of \$200,000 should be made, of which sum \$75,000 for surveys and \$125,000 for contingencies, including incidental repairs of harbors.

MISSISSIPPI RIVER COMMISSION.

This Commission, organized under the provisions of the act of Congress of June 28, 1879, reports to and receives instructions from the Secretary of War through this office.

The Secretary of War transmitted to the House of Representatives, January 7, 1889, a supplemental report from the Commission of December 28, 1888, upon the present condition of the improvements on the Mississippi River, under its charge, and the results accomplished to date. This report was printed as House Ex. Doc. No. 64, Fiftieth Congress, second session. (See also Appendix V V 1.)

The report of the Commission for the fiscal year ending June 30, 1889, embracing the following subjects, viz: (1) Surveys and examinations; (2) Construction; (3) Financial statement; and (4) Estimates, will be found in Appendix V V 2.

The estimate of funds required for the service of the Commission for the fiscal year ending June 30, 1891, is stated in the above report as follows:

ESTIMATE OF FUNDS FOR THE MISSISSIPPI RIVER COMMISSION FOR THE FISCAL YEAR
ENDING JUNE 30, 1891.

Sundry civil bill.

Mississippi River Commission.—For salaries, inspections, and traveling expenses of the Mississippi River Commission; for printing and telegraphing; for office expenses and miscellaneous \$35,000

River and harbor bill.

For surveys and examinations of the Mississippi River from the Head of the Passes to its headwaters, continuing survey.....	150,000
For improving the Mississippi River from the Head of the Passes to the mouth of the Ohio River.....	4,000,000
For work at—	
Hickman, Ky., continuing improvement	111,250
Greenville, Miss., continuing improvement	350,000
Vicksburg, Miss., continuing improvement.....	175,000
Natchez, Miss., continuing improvement.....	250,000
New Orleans, La., continuing improvement.....	200,000
For rectification of Red and Atchafalaya rivers.....	350,000

MISSOURI RIVER COMMISSION.

This Commission, organized under the provisions of the act of July 5, 1884, reports to and receives instructions from the Secretary of War through this office.

The report of the Commission describing the operations in its charge for the fiscal year ending June 30, 1889, will be found in Appendix W W.

The estimate of funds required for the service of the Commission for the fiscal year ending June 30, 1891, is stated in the above report as follows:

ESTIMATES FOR WORKS OF IMPROVEMENT FOR THE FISCAL YEAR ENDING JUNE
30, 1891.

Salaries of Commission, office and traveling expenses, surveys, permanent bench-marks, gauges, etc.....	\$150,000
For improvements at Sioux City, Iowa	100,000
Omaha, Nebr.....	150,000

For improvements at Plattsmouth, Nebr.....	\$100,000
Nebraska City, Nebr.....	150,000
Rulo, Nebr.....	100,000
St. Joseph, Mo.....	150,000
Atchison, Kans.....	175,000
Leavenworth, Kans.....	100,000
Kansas City, Mo.....	175,000
Miami, Mo.....	75,000
Arrow Rock, Mo.....	100,000
For improvement of the river above Sioux City, Iowa.....	175,000
For snagging operations below Sioux City, Iowa.....	60,000
For general improvement of the river.....	1,000,000
Total.....	2,760,000

HARBOR LINES.

The river and harbor act of August 11, 1888, provides :

SEC. 12. Where it is made manifest to the Secretary of War that the establishment of harbor lines is essential to the preservation and protection of harbors, he may, and is hereby authorized to, cause such lines to be established, beyond which no piers or wharves shall be extended or deposits made except under such regulations as may be prescribed from time to time by him.

Under the requirements of this section the Secretary of War has caused such lines to be established at the following localities :

HARBOR LINES AT MARQUETTE HARBOR, MICHIGAN.

It being manifest to the Secretary of War that the establishment of harbor lines is essential to the preservation and protection of the harbor at Marquette, Michigan, he approved the recommendation of the Chief of Engineers, that their establishment be undertaken, and that the subject be referred to a Board of Engineers.

A Board was accordingly constituted by his authority November 19, 1888, composed of the following members: Maj. Charles J. Allen, Maj. Chas. E. L. B. Davis, and Maj. James B. Quinn, Corps of Engineers.

The Board assembled at Marquette November 27, 1888, and after making the necessary examination of the harbor, and such investigations as were required, submitted its report, with accompanying maps, dated January 12, 1889.

The report was submitted to the Secretary of War by the Chief of Engineers, with recommendation "that the line herein described for adoption and also represented in the accompanying map, No. 1, signed by the members of the Board, be established" * * * "as the harbor lines of Marquette Harbor, Michigan, beyond which no piers or wharves shall be built or deposits made."

This recommendation was approved by the Secretary of War January 20, 1889.

(See Appendix H H 12.)

HARBOR LINES FOR NORFOLK AND PORTSMOUTH HARBORS, IN VIRGINIA.

An advisory board to the State harbor commissioners of Virginia, in determining the harbor lines at Norfolk and Portsmouth, was, at the request of the governor of Virginia, appointed by the President of the United States in 1875, with instructions to report to the Secretary of War, and was in existence at the time that the river and harbor act of August 11, 1888, took effect.

This Board was dissolved, by direction of the President, February 2, 1889, and a Board was constituted for the establishment of the harbor lines referred to, composed of the following members: Col. William P. Craighill, Lieut.-Col. Peter C. Hains, and First Lieut. G. J. Fieberger, Corps of Engineers.

The Board submitted a preliminary report, dated March 26, 1889, and accompanying map showing the harbor lines for the harbors of Norfolk and Portsmouth recommended by it. This report was submitted by the Chief of Engineers to the Secretary of War, March 29, 1889, with recommendation that the lines described and drawn upon the accompanying map be approved, and that such approval be noted on the face of the map. This recommendation was approved by the Secretary of War, April 10, 1889.

(See Appendix J 11.)

HARBOR LINES FOR SAVANNAH HARBOR, GEORGIA.

It being manifest to the Secretary of War that the establishment of harbor lines in the harbor of Savannah, Ga., is essential to its preservation, upon recommendation of the Chief of Engineers, he directed that a Board of Engineer Officers be constituted to examine and report upon the same. A Board was accordingly constituted February 4, 1889, composed of the following officers: Col. William P. Craighill, Capt. William H. Bixby, and First Lieut. O. M. Carter, Corps of Engineers.

The Board met at Savannah February 20, 1889, and having examined the harbor, and considered its importance, deemed it proper to submit a preliminary report, dated February 20, 1889, recommending that the Secretary of War direct that for the present no wharf or other structure be allowed to be built beyond the bulkhead lines suggested by Lieutenant Carter and shown on the tracing accompanying his letter to the Chief of Engineers January 23, 1889. This report was submitted to the Secretary of War with favorable recommendation, and was approved by him March 1, 1889.

The Board, after giving notice that it would hold a public meeting in Savannah, and requesting all interested parties to be present, gave the subject before it the full examination its importance demanded, and submitted its final report April 1, 1889, with accompanying tracing upon which the proposed harbor lines were drawn. This report was submitted to the Secretary of War April 24, 1889, with recommendation "that the lines selected be approved and that the approval be placed upon the tracing submitted." This recommendation was approved May 3, 1889.

(See Appendix O 12.)

HARBOR LINES AT BRUNSWICK HARBOR, GEORGIA.

It being manifest to the Secretary of War that the establishment of harbor lines is essential to the preservation and protection of the harbor of Brunswick, Ga., upon the recommendation of the Chief of Engineers, he directed that a Board of Engineers be constituted to consider and report upon the subject. A Board was accordingly appointed March 22, 1889, composed of the following members: Col. William P. Craighill, Capt. William H. Bixby, and First Lieut. O. M. Carter, Corps of Engineers.

The Board assembled at Brunswick March 30, where, in response to a notice from it, many persons, among them members of the city council, appeared. After conference with the persons present and an examination of the harbor and the data relating to it, the Board submitted its report, dated April 1, 1889, with accompanying tracing on which the proposed harbor line is drawn. The report was submitted to the Secretary of War April 24, with recommendation for approval, and was approved by him May 3, 1889.

(See Appendix O 13.)

HARBOR LINES OF NEW YORK HARBOR.

It being manifest to the Secretary of War that the establishment of harbor lines for New York Harbor is essential to the preservation and protection of the harbor, on October 4, 1888, he approved the recommendation of the Chief of Engineers that The Board of Engineers stationed at New York City be constituted the Board to establish harbor lines for that harbor and its vicinity.

The Board submitted a report March 26, 1889, and tracing of harbor lines proposed by the department of docks for the city of New York, for East River between Fifty-ninth street and Sixty-fourth street, and recommended the project for approval, as the design will not encroach upon the lines which will be ultimately recommended by the Board.

Upon the recommendation of the Chief of Engineers the lines were approved by the Secretary of War April 11, 1889.

The Board also submitted a report June 4, 1889, and an accompanying tracing on which the proposed lines for the north and east shores of Staten Island, from New Brighton to Fort Wadsworth, are drawn, which lines were, upon the recommendation of the Chief of Engineers, approved by the Secretary of War June 21, 1889.

(See Appendix E 14.)

HARBOR LINES AT BOSTON HARBOR, MASSACHUSETTS.

It being manifest to the Secretary of War that the establishment of harbor lines is essential to the preservation and protection of Boston Harbor, he orally directed that the subject be referred to a board of officers of the Corps of Engineers to make the necessary examinations and investigations, and upon recommendation of the Chief of Engineers, which was approved by the Secretary August 13, 1888, a Board of Engineers was constituted to establish the harbor lines of Boston, Mass., composed of the following members: Col. Henry L. Abbot, Lieut. Col. George L. Gillespie, and Maj. William R. Livermore, Corps of Engineers. Subsequently (January 30, 1889), Lieut. Col. S. M. Mansfield, Corps of Engineers, was added to the Board.

The Board submitted its first report, dated July 20, 1889, with accompanying tracing, upon which the harbor lines so far as determined have been drawn, and the lines were, upon the recommendation of the Chief of Engineers, approved by the Secretary of War, July 29, 1889.

(See Appendix B 22.)

BRIDGING NAVIGABLE WATERS OF THE UNITED STATES.

The plans and locations of the following bridges authorized by acts of Congress, having been found to comply with the requirements of said acts, have been approved by the Secretary of War, and copies sent to the officers of the Corps of Engineers in charge of the river and har-

bor districts in which the bridges are to be built, in order that they might supervise the construction so far as to see that the bridges are built in accordance therewith:

1. *Bridge of the county of Laurens, Georgia, across the Oconee River, at or near Dublin.*—Act approved June 18, 1888.

Plan and location submitted by the Ordinary of Laurens County, Georgia, May 16, 1888; approved by the Secretary of War August 17, 1888; copy sent to Capt. R. L. Hoxie, Corps of Engineers, August 24, 1888.

2. *Bridge of Kansas City and Memphis Railway and Bridge Company across the Mississippi River, at Memphis, Tennessee.*—Act approved April 24, 1888. (See Appendix W W 22, Report of the Chief of Engineers, 1888, pages 2514-2525.)

Plan and location submitted by the company August 3, 1888; approved by the Secretary of War August 23, 1888; copy sent to Capt. S. S. Leach, Corps of Engineers, September 25, 1888.

3. *Bridge over the Menomonee River by the municipalities of Menomonee, Michigan, and Marinette, Wisconsin.*—Act approved July 29, 1886.

Plan and location submitted by the Mayor of Menomonee, Mich., August 15, 1888, approved by the Secretary of War September 10, 1888.

Maj. Chas. E. L. B. Davis, Corps of Engineers, reports that the bridge has been built in accordance with the conditions and plans approved by the Secretary of War.

4. *Bridge of the St. Louis Merchants' Bridge Company, of St. Louis, Missouri, over the Mississippi River at St. Louis, Missouri.*—Act approved February 3, 1887, and amendatory act approved September 10, 1888.

Plan and location submitted by the bridge company October 11, 1888; approved by the Secretary of War November 14, 1888; copy sent to Maj. A. M. Miller, Corps of Engineers, December 5, 1888.

5. *Bridge of the Yadkin Valley Railway Company across the Cape Fear River at Fayetteville, North Carolina.*—Act approved June 6, 1888.

Plan and location submitted by the Chief Engineer of the railway company September 14, 1888; approved by the Secretary of War December 1, 1888; copy sent to Capt. W. H. Bixby, Corps of Engineers, December 29, 1888.

6. *Reconstruction of the bridge over the Ohio River at Steubenville, Ohio, by the Pittsburgh, Cincinnati and St. Louis Railway Company, successors of the Western Transportation Company, who originally built the bridge in question in accordance with the provisions of section 1 of "An act to establish certain post roads," approved July 14, 1862.*

The channel span as well as the other spans of the bridge were originally built in 1863-'64 for a single-track railroad, but the increasing traffic demands that it be reconstructed for a double track, all the spans excepting the channel span having been so reconstructed during the past year. The rebuilding of the channel span will require during reconstruction scaffolding for its support to be placed in the channel, which for a period of about two months will obstruct navigation, and for this work the approval of the Secretary of War was asked. The subject having received his attention, and the officer in charge of the improvement of the Ohio River having recommended that the railroad company be authorized to rebuild the channel span, under the conditions that the channel span be erected "during the months of July and August, 1889," and that "all preparations be made so as to reduce the obstruction to the least period of time, giving proper notice by publication to the navigation interests of the fact that the channel will be obstructed during the

period above named," * * * and "if in the judgment of the engineer in charge it should be deemed advisable to dredge the channel of one of the adjoining spans so as to afford the necessary depth of water, any requirements that may be deemed desirable in this respect" will be complied with, the Secretary of War approved the same December 22, 1888.

7. *Bridge across the Red River of the North at Des Mers avenue, city of Grand Forks, Dakota.*—Act approved May 21, 1888.

Plan and location submitted by the Mayor of the city of Grand Forks, Dak., November 5, 1888; approved by the Secretary of War January 3, 1889; copy sent to Maj. Chas. J. Allen, Corps of Engineers, January 15, 1889.

The original plan provided for trestle-work approach on the west side of the river; a modified plan substituting filling for trestle-work was submitted April 16, 1889, approved by the Secretary of War June 11, 1889, and Major Allen advised of the modification June 15, 1889.

8. *Bridge of the Chicago, Kansas City and Texas Railway Company over the Missouri River at the most accessible point between the city of Kansas and town of Sibley, Missouri.*—Act approved March 3, 1887.

Plan and location submitted by the president of the railway company January 8, 1889; approved by the Secretary of War, February 14, 1889; copy sent to Lieut. Col. C. R. Sutor, Corps of Engineers, president Missouri River Commission, March 11, 1889.

9. *Bridge over the Snake River near Texas Ferry, Washington Territory, by the Oregon Railway and Navigation Company.*—Act approved July 9, 1888.

Plan and location submitted by the Chief Engineer of the company, August 31, 1888; approved by the Secretary of War, February 19, 1889; copy sent to Maj. W. A. Jones, Corps of Engineers, March 1, 1889.

Bridge completed April 30, 1889.

10. *Bridge of the Louisville and Jeffersonville Bridge Company across the Ohio River between Louisville, Kentucky, and Jeffersonville, Indiana,* under acts "authorizing the construction of bridges over the Ohio River, and to prescribe the dimensions of the same," approved December 17, 1872, an act supplementary to that act approved February 14, 1883.

The plans for the bridge in question, submitted April 30, 1888, were referred to a Board of Engineers in accordance with the requirements of the acts, which reported upon the same June 13, 1888, with recommendation—

1. That the proposed bridge be moved further up the river to some point at or above Wall street, in Jeffersonville, and that it be built with a channel span near the Indiana shore of 500 feet in the clear, and one near the island shore of 400 feet in the clear.

2. If the present location be accepted, the Board, while strongly disapproving of it, recommends that there be a span at least 650 feet wide in the clear near the Indiana shore, with the Indiana pier at low-water mark, and a span at least 400 feet in the clear near the island shore, with the Kentucky pier at low-water mark on the island.

The subject elicited much discussion, and finally, upon the presentation of a plan giving a span of 650 feet in the clear on the Indiana side, and a span of 400 feet in the clear on the Kentucky side, which was found to comply with the recommendations of the Board of Engineers, with the views of the Chief of Engineers, and also with the existing law regulating the height of bridges across the Ohio River, the plan was approved by the Secretary of War, February 28, 1889.

Copy sent to Maj. Amos Stickney, Corps of Engineers, March 12, 1889.

The reports in regard to this bridge were published in House Ex. Doc. No. 29, Fiftieth Congress, second session.

11. *The Pittsburgh and Lake Erie Railroad Company* submitted plans for the false work required in connection with the reconstruction of a portion of the superstructure of its bridge across the Ohio River at Beaver, Pennsylvania, erected in 1878, under the provisions of "An act to authorize the construction of bridges across the Ohio River, and to prescribe the dimensions of the same," approved December 17, 1872.

The railroad company finding it necessary to rebuild a portion of the superstructure of the bridge in question made application November 26, 1888, to the Secretary of War for his authority for that purpose, and also for his approval of the false work necessary to its construction. The drawings submitted by the company having been found upon examination to involve no changes in the piers or approaches were approved by the Secretary of War March 25, 1889, upon condition that—

1st. One of the high spans shall at all times be open to navigation, and neither of the high spans shall be obstructed before June of the year when the repairs are to be made.

2d. The superstructure shall be ready for erection as soon as the false work is finished, and the whole work of repair and the restoration of the channel shall proceed with the utmost possible rapidity.

Which conditions were accepted by the railroad company February 28, 1889.

12. *Bridge of the Louisville Southern Railway Company over the Kentucky River near Tyrone, Kentucky.*—Act approved October 9, 1888.

Plan and location submitted by the chief engineer of the company January 25, 1889; approved by the Secretary of War March 30, 1889; copy sent to Maj. D. W. Lockwood, Corps of Engineers, April 8, 1889.

13. *Amended location of the bridge of the Wheeling and Harrisburg Railway Company across the Ohio River from Wheeling, West Virginia, to Martin's Ferry, Ohio.*—Act approved December 17, 1872, and supplementary act approved February 14, 1883.

The original location of the bridge was approved by the Secretary of War December 10, 1883. The location as then presented was askew to the current of the river. The drawing showing the amended location was submitted by the president of the company April 22, 1889, and having been found satisfactory, it being at right angles to the course of the stream, thus removing the necessity of an askew bridge, as previously designed, was approved by the Secretary of War May 18, 1889. A copy of the approval, with instructions relative to supervising the construction of the work, was sent to Lieut. Col. W. E. Merrill, Corps of Engineers, May 24, 1889.

14. *Bridge across the Red River of the North at Minnesota avenue, in the city of Grand Forks, Dakota.*—Act approved May 21, 1888, and amendatory act approved March 1, 1889.

It having been found that the bridge at Minnesota avenue, authorized by the act approved May 21, 1888, could not be erected at the locality named in accordance with the requirements of that act, upon representation to that effect by parties interested, Congress passed the amended act approved March 1, 1889, which in effect legalized the construction of the bridge in accordance with the plans submitted by the Mayor of Grand Forks November 5, 1888, under the act approved May 21, 1888. These plans, conforming to the requirements of the amended act, were approved by the Secretary of War May 29, 1889. Copies of the approved plan and location were sent to Maj. Charles J. Allen, Corps of Engineers, June 12, 1889, with the instructions relative to supervising the construction of the work.

15. *Bridge of the Alabama Midland Railway Company across the Flint River near the city of Bainbridge, Georgia.*—Act approved August 6, 1888.

Plan and location submitted by the president of the railway company May 4, 1889; approved by the Secretary of War June 12, 1889; copy sent to Capt. P. M. Price, Corps of Engineers, July 1, 1889.

16. *Bridge of the Alabama Midland Railway Company across the Chattahoochee River, at or near the town of Gordon, Alabama.*—Act approved August 6, 1888.

Plan and location submitted by the president of the railway company May 4, 1889; approved by the Secretary of War June 12, 1889; copy sent to Capt. P. M. Price, Corps of Engineers, July 1, 1889.

17. *Bridge of the commissioners of Morgan County, Ohio, across the Muskingum River at Stockport, Ohio.*—Act approved April 2, 1888.

Plan and location submitted by the Commissioners of Morgan County, Ohio, June 18, 1888; approved by the Secretary of War August 14, 1888; copy sent to Lieut. Col. W. E. Merrill, Corps of Engineers, August 24, 1888.

Subsequently, June 3, 1889, it having been discovered that the pivot pier of the draw-span of the bridge had been accidentally located at a point 10 feet west of the position indicated upon the drawings approved by the Secretary of War, upon petition from the auditor of Morgan County in behalf of the Commissioners that the *adopted* location be approved instead of that approved August 14, 1888, it having been reported by Colonel Merrill that the change would not be injurious to navigation, the Secretary of War approved the same June 15, 1889, and Colonel Merrill was advised June 17, 1889.

18. *Bridge of the Fort Smith and Choctaw Bridge Company across the Poteau River, Choctaw Nation, near Fort Smith, Arkansas.*—Acts approved June 18, 1888, and March 2, 1889.

Plan and location submitted by the president of the bridge company May 27, 1889; approved by the Secretary of War June 18, 1889; copy sent to Capt. H. S. Taber, Corps of Engineers, June 25, 1889.

19. *Bridge of the Kentucky Union Railway Company over the North Fork of Kentucky River, at mouth of Walker's Creek.*—Act approved March 1, 1889.

Plan and location submitted by the Chief Engineer of the railway company May 18, 1889; approved by the Secretary of War June 19, 1889; copy sent to Maj. D. W. Lockwood, Corps of Engineers, July 1, 1889.

20. *Bridge over the Missouri River between the city of Leavenworth, in the State of Kansas, and Platte County, in the State of Missouri.*—Act approved February 25, 1889.

The structure is to be built as a ponton bridge.

Plan and location submitted by Leavenworth and Platte County Bridge Company April 22, 1889; approved by the Secretary of War June 20, 1889; copy sent Lieut. Col. C. R. Suter, Corps of Engineers, July 2, 1889.

21. *Bridge of the Randolph and Kansas City Bridge Company to be constructed across the Missouri River at a point to be selected between Kansas City, Missouri, and a point five miles below that city.*—Act approved July 23, 1888.

The act provides for the construction of a ponton draw-span bridge.

Plan and location submitted by the bridge company May 21, 1889; approved by the Secretary of War June 26, 1889; copy sent to Lieut. Col. C. R. Suter, Corps of Engineers, July 9, 1889.

INTERFERENCES WITH NAVIGATION BY BRIDGES, CAUSEWAYS, AND OTHER STRUCTURES.

Under the requirements of section 2 of the river and harbor act approved July 5, 1884, and section 4 of the river and harbor act approved August 5, 1886, there are submitted herewith reports of officers in charge of river and harbor districts of instances, not heretofore reported, where bridges, causeways, and other structures, erected or in process of erection, do or will interfere with safe navigation.

(See Appendix X X.)

OCCUPANCY OF AND INJURY TO PUBLIC WORKS BY CORPORATIONS AND INDIVIDUALS.

Under the requirements of section 2 of the river and harbor act approved July 5, 1884, and section 4 of the river and harbor act approved August 5, 1886, there are submitted herewith reports of officers in charge of river and harbor districts of instances, not heretofore reported, in which piers, breakwaters, or other works built by the United States in aid of commerce or navigation, are used, occupied, or injured by corporations or individuals.

(See Appendix Y Y.)

BRIDGES OBSTRUCTING NAVIGATION.

The river and harbor act of August 11, 1888, provides as follows:

SEC. 9. That whenever the Secretary of War shall have good reason to believe that any railroad or other bridge now constructed, or which may hereafter be constructed, over any of the navigable water-ways of the United States is an obstruction to the free navigation of such waters, by reason of insufficient height, width of span, or otherwise, or where there is difficulty in passing the draw-opening or the raft-span of such bridge by rafts, steam-boats, or other water-craft, it shall be the duty of the said Secretary to give notice to the persons or corporations owning or controlling such bridge to so alter the same as to render navigation through or under it free, easy, and unobstructed; and in giving such notice he shall prescribe in each case a reasonable time in which such alteration is to be made. If, at the end of such time, the alteration has not been made, the Secretary of War shall forthwith appraise [apprise] the Attorney-General of the United States, whose duty it shall be to institute suit, in the name of the United States, without delay, in the circuit or district court of the United States for the circuit in which such bridge is located, which court is hereby invested with jurisdiction for this purpose, to recover from the owners or managers of such bridge the fines mentioned in the succeeding sections of this act.

SEC. 10. That the owner or owners or manager or managers of any railroad or other bridge obstructing the free navigation of any navigable water-way of the United States who shall willfully fail or refuse to remove the same, or to cause the necessary alterations to be made in the same so as to render navigation through or under it free, easy, and unobstructed to rafts, steam-boats, or other water-craft, after receiving notice to that effect from the Secretary of War and within the time prescribed by him, shall be subject to a fine as penalty therefor of five hundred dollars per month for the time he or they are in default, and the amount so recovered shall be placed to the credit of the improvement fund of the water-way obstructed by such bridge.

In obedience to the above requirements, the Secretary of War notified the persons or corporations owning or controlling certain bridges to so alter the same as to render navigation through or under them free, easy, and unobstructed, and prescribed in each case a reasonable time when such alteration is to be made, as follows:

1. *Bridge across the Mississippi River above Hannibal, Missouri, owned by the Hannibal Bridge Company and controlled by the Wabash Railway Company.*—Notice dated November 8, 1888, was served upon the Han-

nibal Bridge Company November 17, 1888, and upon the Wabash Railway Company November 30, 1888; required alteration to be made and completed on or before the 1st day of March, 1889.

Upon representations made to the Secretary of War that it was desirable and reasonable to extend the time in which to perform the said work, he caused notices dated March 18, 1889, to be served upon the Hannibal Bridge Company, the Wabash Railway Company, and the Missouri, Kansas, and Texas Railway, and notice, dated April 17, 1889, to be served on the Missouri Pacific Railway, reciting in each of the notices the original notice of November 8, 1888, to the Hannibal Bridge Company and the Wabash Railway Company, and extending the time in which the alteration of the bridge shall be done to the 1st day of July, 1889. Up to that time no action had been taken by the companies interested.

2. *Bridge of the Memphis and Charleston Railroad Company across the Tennessee River at Florence, Alabama.*—Notice dated November 20, 1888, was given to the East Tennessee, Virginia and Georgia Railway Company, operating the bridge over the Tennessee River at Florence, Alabama, and notice dated January 11, 1889, to the Memphis and Charleston Railroad Company, and the 1st day of June, 1889, was prescribed as the time when the required alteration should be made and completed.

The Memphis and Charleston Railroad Company, under date of March 2, 1889, submitted plans for the new draw-span proposed to be placed in the bridge, which were not recommended by the Chief of Engineers for approval, and the matter having been referred by the Secretary of War to the Acting Judge-Advocate-General, United States Army, was returned by him May 23, 1889, with report, of which the following is an extract:

The time given by the Secretary of War in which to make the alteration will not expire until the 1st of June, 1889. He is not required or authorized by the act referred to to do anything in this matter at the present time. The act does not contemplate his approving or disapproving particular plans of alterations, but simply his giving to the bridge owners notices to alter their bridges so as to accomplish a certain purpose, and leaves it to them to make any alteration which will do this, or become liable to the penalty.

It appears * * * that the officers of the Memphis and Charleston Railroad Company have been under the impression that it was necessary for them to submit plans of alteration for the approval of the Secretary of War, and * * * in consequence of this erroneous understanding much time has been lost * * * and as the company does not appear to have acted in bad faith it seems right that the time be extended.

Acting upon this opinion of the Judge-Advocate-General, the Secretary of War, upon the recommendation of the Chief of Engineers, dated June 1, extended the time for completing the alteration to December 1, 1889.

3. *Bridge of the Fitchburg Railroad Company over the Charles River, Massachusetts, within the limits of the city of Boston.*—Notice, dated November 21, 1888, was served upon the Railroad Company, prescribing the 1st day of January, 1891, as the time when the required alteration is to be made and completed.

4. *Bridge of the Old Colony Railroad Company across the Taunton River, at Somerset, Massachusetts.*—The Secretary of War, upon representations made to him by responsible parties interested in the navigation of the Taunton River, in July, 1887, having reason to believe that the bridge referred to was such an obstruction to navigation as came within the provisions of Section 8 of the river and harbor act approved July 5, 1884, directed that action be taken under that section, and caused notice to be served upon the Old Colony Railroad Company

requiring it to cause such aids to the passage of the draw-openings or raft span or both, to be constructed at its own expense, in the form of booms, dikes, piers, etc., as should be specified by his order in that behalf.

Such notice was served upon the Old Colony Railroad Company April 28, 1888.

The Railroad Company having failed to comply with the requirements of the Secretary of War, as provided for in the section 8 referred to, it was decided, in addition, to take action under the provisions of sections 9 and 10 of the river and harbor act of August 11, 1888, and the requisite notice, dated November 28, 1888, was served upon the Railroad Company (through its president,) prescribing the 1st day of May, 1889, as a reasonable time when the required alteration is to be made and completed.

The Railroad Company having failed to carry out the requirements of the Secretary of War, imposed upon him by the acts referred to, upon the recommendation of the Chief of Engineers, dated May 14, 1889, he referred the matter to the Department of Justice with request that action be taken as prescribed by sections 9 and 10 of the river and harbor act of August 11, 1888, and the subject was intrusted to the United States attorney for the district of Massachusetts, with instructions to bring proceedings under the provisions of the sections referred to.

5. *Bridge of the Chicago and West Michigan Railway Company across the St. Joseph River, Michigan, near its mouth.*—Notice dated December 4, 1888, was served upon the president of the railway company, and designating April 30, 1889, as a reasonable time in which the required alteration is to be made and completed. A request was made by the company, April 20, 1889, that the changes they were making in the draw be put to the test of trial, which was deemed to be a reasonable one, and upon recommendation of the Chief of Engineers, dated May 6, 1889, "that no further notice be given the company at present, it being distinctly understood that such delay is not to be construed as an approval of the structure as it now exists," the recommendation was approved by the Secretary of War May 17, 1889. No further action has been taken in the matter.

6. *Bridges across the Charles River, Massachusetts.*—Notice dated December 6, 1888, was served on the city of Boston in reference to bridges across Charles River, known as Charles River Bridge and Warren Bridge, within the limits of the city of Boston, prescribing the 1st day of January, 1891, as the time when the required alterations are to be made and completed.

Notice was served on the Boston and Maine Railroad Company, dated December 6, 1888, in reference to the bridge built by that company across the Charles River, and the bridge erected by the Eastern Railroad Company and controlled by the Boston and Maine Railroad Company, both of them within the limits of the city of Boston, and also in reference to the two bridges erected by the Boston and Lowell Railroad Company and controlled by the Boston and Maine Railroad Company, across the Charles River between the cities of Boston and Cambridge, obstructing the navigation of the Charles River, prescribing the 1st day of January, 1891, as the time when the required alterations are to be made and completed.

Notice dated December 6, 1888, was served upon the Commissioners on West Boston, Canal, and Prison Point bridges controlled by them, in reference to the bridges across the Charles River known as West Boston Bridge, and Canal, or Craigies, Bridge, and prescribing the 1st day of

January, 1891, as the time when the required alterations are to be made and completed.

7. *Bridge over the Muskingum River, Ohio, between the towns of Beverly and Waterford.*—Notice dated December 8, 1888, was served upon the commissioners of Washington County, Ohio, prescribing the 30th day of September, 1889, as the time when the required alterations are to be made and completed.

8. *Keokuk and Hamilton Bridge across the Mississippi River at Keokuk, Iowa.*—Notice dated December 19, 1888, was served upon the Keokuk and Hamilton Bridge Company, prescribing the 31st day of March, 1889, as the time when the alterations are to be made and completed.

The bridge company having failed to comply with the requirements of the Secretary of War, contained in the notice referred to, the matter was, upon the recommendation of the Chief of Engineers, referred by the Secretary of War, April 13, 1889, to the Attorney-General of the United States, with request for such action as is required by law.

The case is in the hands of the United States attorney for the southern district of Iowa.

9. *Bridges across the White River, Indiana.*—1. Notice dated December 19, 1888, was served upon the Evansville and Terre Haute Railroad Company, prescribing the 1st day of January, 1890, as a reasonable time when the alteration is to be made and completed.

2. Notice dated December 19, 1888, was served upon the Evansville and Indianapolis Railroad Company, operating railroad bridge at Rogers, Ind., on White River, one-half mile above its forks, prescribing the 1st day of January, 1890, as a reasonable time when the required alteration is to be made and completed.

10. *Bridge of the St. Paul and Duluth Railway Company across the St. Louis River from Grassy Point, Minnesota.*—Notice dated January 2, 1889, was served upon the St. Paul and Duluth Railway Company, prescribing the 1st day of September, 1889, as the time when the required alteration is to be made and completed.

11. *Bridges across the Kentucky River.*—1. Notice dated January 2, 1889, was served upon the Mayor of the city of Frankfort, Ky., in regard to the bridge over the Kentucky River, at foot of St. Clair street, in that city, prescribing the 1st day of January, 1890, as the time when the required alteration is to be made and completed.

Upon request of the Authorities of Franklin County and of the city of Frankfort, dated July 9, 1889, the time for completing the alterations was extended by the Secretary of War to January 1, 1891.

2. Notice dated January 2, 1889, was served upon the Louisville and Nashville Railroad Company in regard to the railroad bridge across the Kentucky River at Frankfort, Ky., prescribing that the required alteration is to be completed on or before the 1st day of January, 1890. The time for completing the alteration was subsequently extended to January 9, 1891.

3. Notice dated January 2, 1889, was served upon the Louisville and Nashville Railroad Company, operating and controlling the railroad bridge at Worthville, Ky., prescribing the 1st day of January, 1890, as time when the required alteration is to be made and completed. The time for completing the alteration was subsequently extended to January 9, 1891.

12. *Bridge of Raritan River Railroad Company across the South River, New Jersey.*—Notice dated January 22, 1889, was served upon the President of the Raritan River Railroad Company, and the time in which such alteration is to be made and completed was prescribed as June 1,

1889. This time was extended first to July 11, 1889, and then to July 21, 1889. No action appears to have been taken under the notice of the Secretary of War above referred to.

13. *Bridge across or near the mouth of Moodna, or Murderer's, Creek, in Cornwall, Orange County, in the State of New York.*—Notice dated January 28, 1889, was given to the New York Central and Hudson River Railroad Company, lessee of the West Shore Railroad, via west shore of the Hudson River, prescribing the 1st day of July, 1889, as the time when the required alteration is to be made and completed. The railroad company having failed to comply with the notice of the Secretary of War within the prescribed time, the subject was brought to the attention of the Attorney-General of the United States July 23, 1889, with request that he take the action prescribed by sections 9 and 10 of the river and harbor act of August 11, 1888.

14. *Bridge of the St. Louis, Arkansas and Texas Railroad Company across the St. Francis River, Arkansas.*—Notice dated February 10, 1889, was served upon the St. Louis, Arkansas and Texas Railroad Company, and the 1st day of September, 1889, was prescribed as the time when the required alteration is to be made and completed.

15. *Bridge of the Florida Railway and Navigation Company across Kingsley's Creek, a part of the inland communication between Savannah, Georgia, and Jacksonville, Florida.*—Notice dated March 2, 1889, was given to the Florida Railway and Navigation Company, and the 15th day of April, 1889, was prescribed as the time when the required alteration is to be made and completed. Upon application from the receiver of the Florida Railway and Navigation Company, the time for completing the alteration was extended to May 1, 1889.

This bridge has been provided with a draw-span 56.7 feet in width, which is sufficient for the purposes of navigation.

16. *Bridges across the Muskingum River, Ohio.*—Notice dated March 18, 1889, was served upon the Commissioners of Muskingum County, Ohio, owning or controlling the canal of the Muskingum River navigation at Zanesville, in reference to bridge over the canal at that place, prescribing the 1st day of November, 1889, as the time when the required alteration is to be made and completed. Also,

Notice dated March 18, 1889, was served upon the Commissioners of Muskingum County, Ohio, owning or controlling the bridge across the Muskingum River at the head of Fifth street, Zanesville, Ohio, known as the Fifth Street Bridge, prescribing the 1st day of November, 1889, as a reasonable time in which the required alteration is to be made and completed.

Notice dated March 20, 1889, was served upon the Commissioners of Washington County, Ohio, owning or controlling the Lowell Canal, in reference to the bridge across the canal, prescribing the 1st day of November, 1889, as a reasonable time when the required alteration is to be made and completed.

17. *Bridge of the East Tennessee, Virginia and Georgia Railway Company across the Ocmulgee River, Georgia, near Lumber City.*—This bridge having been reported as an obstruction to navigation, notice dated April 12, 1889, was served upon the East Tennessee, Virginia and Georgia Railway prescribing the 1st day of August, 1889, as a reasonable time when the required alteration is to be made and completed.

18. *Bridges across Lumber River, North Carolina,* as follows: At Fair Bluff, at Princess Ann, at Ivey Bluff, at Phillips, and at Mathews Bluff, owned jointly by the counties of Robeson and Columbus, in the State of North Carolina.

Notices dated April 19, 1889, to the Boards of Commissioners of Columbus and Robeson counties, North Carolina, were served May 7, 1889.

A period of six months from November 7, 1889, was prescribed by the Secretary of War as a reasonable time within which the required alterations are to be made and completed.

MISCELLANEOUS.

[Public works not provided for in acts making appropriations for the construction, repair, and preservation of works on rivers and harbors.]

MAINTENANCE AND REPAIRS OF WASHINGTON AQUEDUCT—INCREASING WATER SUPPLY OF THE CITY OF WASHINGTON—WATER SUPPLY, DISTRICT OF COLUMBIA, ACT MARCH 2, 1889—ERECTION OF FISHWAYS AT THE GREAT FALLS OF THE POTOMAC.

Officers in charge, Maj. G. J. Lydecker, Corps of Engineers, until March 6, 1889, and since that date Lieut. Col. John M. Wilson, Corps of Engineers, Colonel, U. S. Army; First Lieut. O. McD. Townsend, Corps of Engineers, under the immediate orders of the engineer in charge during the entire year.

1. *Washington Aqueduct.*—Operations have been in progress during the year maintaining the aqueduct, gate-houses, reservoirs, and Conduit road in good condition.

Repairs have been made from time to time when necessary; the canal bank near the entrance to the conduit has been strengthened and the grounds improved in that locality; the reservoirs, the gates, valves, revetments, etc., have been kept in order, buildings repaired when necessary, fences repaired and whitewashed, and grounds improved.

The Conduit road has been repaired and improved, about 1,000 cubic yards of broken stone having been used for this purpose.

The freshet which reached its maximum (16 feet over the dam) on the morning of June 2, 1889, did some damage of a minor character in the vicinity of the entrance to the conduit at the Great Falls, all of which was promptly repaired. It also tore some of the coping-stone from the old portion of the dam near Conn's Island, about 1,000 feet from the mouth of the conduit; preparations were at once made for replacing these stone as soon as the level of the water would admit, and the work will be completed at an early day.

Amount appropriated by act of July 18, 1888.....	\$20,000.00
Amount appropriated by act of March 2, 1889.....	20,000.00
	<hr/>
	40,000.00
July 1, 1889, amount expended during fiscal year.....	\$15,946.49
July 1, 1889, outstanding liabilities.....	1,787.17
July 1, 1889, amount to be covered into the United States	
Treasury	2,266.34
	<hr/>
	20,000.00

July 1, 1889, balance available.....	20,000.00
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Amount required for fiscal year ending June 30, 1891, \$20,000, being the same sum as that appropriated for the past ten years for engineering, maintenance, repairs, care of reservoirs, and everything necessary to keep the aqueduct, reservoirs, etc., in good condition.

(See Appendix Z Z 1.)

2. *Increasing water supply of the city of Washington.*—The approved project for this work comprises, first, the extension of the dam at the

Great Falls of the Potomac across Conn's Island and the Virginia Channel to the Virginia shore, and the completion of the whole to an elevation of 143 feet above mean high tide at the navy-yard, this elevation being about 15 inches above the crest of the old dam across the Maryland Channel of the river; second, the extension of the aqueduct by a tunnel 20,696.3 feet long from the distributing reservoir above Georgetown to the site of the new reservoir near Howard University; third, construction of a new reservoir capable of holding about 300,000,000 gallons of water; fourth, making the necessary main connections for taking water from the new reservoir into the system of supply mains for the city.

Operations during the fiscal year were confined to the tunnel; between July 1, 1888, and November 1, 1888, 4,654 linear feet of the tunnel was enlarged to proper dimensions; 3,904 feet cleaned of muck, and 4,547½ feet reported as lined with brick and rubble masonry, making a total of 14,617 feet reported as lined.

In September, 1888, charges were made that improper work was being done under the contract. Investigations were commenced at once and continued by the officer in charge and by special expert engineers under authority of a Congressional committee, and the facts developed proved that systematic frauds had been in progress and much bad work done.

Operations were suspended November 1, 1888, and the pumping in the shafts finally discontinued March 28, 1889; water commenced running out from near the top of Rock Creek shaft on the morning of May 4, 1889.

The openings of the shafts of West connection, Foundry Branch, and Rock Creek have been protected by building fences around them, and the openings at Champlain avenue and the new reservoir will be similarly protected as soon as the contractors remove their head houses and cages.

The old useless buildings at the new reservoir have been sold and removed, and the proceeds of sale turned into the Treasury.

July 1, 1888, amount unexpended on all items of appropriation.....	\$550, 194. 65
July 1, 1889, amount expended during fiscal year.....	\$112, 454. 50
July 1, 1889, outstanding liabilities, retained percentages on contract of Beckwith & Quackenbush, as reported by the predecessor of the officer in charge.....	24, 419. 68
July 1, 1889, amount covered by existing contracts.....	209, 193. 50
	<hr/> 346, 067. 68

July 1, 1889, balance available, (less \$611. 24 disbursed directly from the United States Treasury Department for advertising).....	204, 126. 97
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No appropriation is asked for the next fiscal year.

(See Appendix Z Z 2.)

3. *Water supply, District of Columbia.*—The act of Congress approved March 2, 1889, provides as follows:

Water supply, District of Columbia.—To enable the Secretary of War to cause to be constructed and put in operation a forty-eight inch cast-iron main from the present distributing reservoir above Georgetown, easterly to Rock Creek at M street, and thence along M street to New Hampshire avenue; thence northeasterly along New Hampshire avenue to R street north; thence along R street, to connect with the present forty-eight-inch main from the new reservoir at R and Fourth streets, and to make the necessary connections, and to provide the necessary apparatus for thereby specially supplying the present deficiencies of water at the higher levels of the city, and in general to increase the water supply, five hundred and seventy-five thousand dollars. The said work shall be done under the direction of the Chief of Engineers, in the shortest practicable

time. If it shall appear to the Secretary of War, on the report of the Chief of Engineers, that for any cause the work can not be carried on, or material therefor can not be obtained as rapidly as is necessary for the best and most vigorous prosecution of it, he is authorized to provide material by purchase in open market, or by special contract for the fabrication thereof, and to carry on the work by days' work or otherwise, as it may seem to him expedient. This appropriation shall be charged against the revenues applicable to the expenses of carrying on the government of the District of Columbia, so that one half will be paid from the Treasury of the United States and the other half from moneys derived from taxation in the District.

Within a few days after the appropriation bill became a law work was inaugurated preparing plans and specifications for laying the new 48-inch mains.

Proposals were invited in April for the necessary pipe and valves, and contracts made in May and June with the Gloucester Iron Works of Philadelphia, Pa., the Camden Iron Works of Philadelphia, Pa., and the McNeal Pipe and Foundry Co. of Burlington, N. J., for the pipe and special castings, and with the Mohawk and Hudson Manufacturing Co. of Waterford, N. Y., for the valves.

In addition to the line specially mentioned in the act of Congress it was deemed advisable under the terms of the law to lay a 30-inch main from New Jersey avenue and B street to East Capitol and Eleventh streets, and plans and specifications were prepared for this work and the necessary pipe ordered under contracts already made.

In May a contract was made with Messrs. Springmann & Brother, of Washington, D. C., for hauling the pipe from the depots and wharves to the locality where it is to be laid, and at the close of the year contracts had been awarded to Thomas B. Coyle, of Washington, D. C., for the necessary trenching, to Messrs. Clendenin Brothers, of Baltimore, Md., for the lead, and to Rowland A. Robbins, of New York, N. Y., for the jute required for calking the joints.

By June 30, 4,100 feet of straight pipe, averaging about 1,300 tons, and about 45 tons of special castings, had been cast at the various foundries, 1,405 feet, averaging 472 tons, had been delivered in Washington, and work well advanced upon the valves.

It is hoped and believed, unless unanticipated delay arises in the delivery of the pipe under the various contracts, that before the close of the fiscal year ending June 30, 1890, water will be flowing through the new mains.

Amount appropriated by act of March 2, 1889	\$575,000.00
July 1, 1889, amount expended during fiscal year.....	\$1,751.70
July 1, 1889, outstanding liabilities.....	13,449.73
July 1, 1889, amount covered by existing contracts.....	256,639.79
	<hr/> 271,841.22

July 1, 1889, balance available.....	303,158.78
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No further appropriation is asked for the next fiscal year.

(See Appendix Z Z 3.)

4. *Erection of fish-ways at the Great Falls of the Potomac.*—No work of construction has been in progress during the year.

Plans and specifications for a new system of fish-ways are being prepared under the supervision of the Commissioner of Fish and Fisheries.

By direction of the Secretary of War the construction will be carried on under the direction of the Commissioner above mentioned, the engineer in charge being held responsible only for the proper protection of the dam at the Great Falls and for the disbursement of the funds appropriated.

July 1, 1888, amount available.....	\$30,226.32
July 1, 1889, amount expended during fiscal year.....	\$32.00
July 1, 1889, outstanding liabilities.....	150.00
	<hr/> 182.00
July 1, 1889, amount available.....	\$0,044.32

No further appropriation is requested for the next fiscal year.

(See Appendix Z Z 4.)

**IMPROVEMENT AND CARE OF PUBLIC BUILDINGS AND GROUNDS
AND CARE AND COMPLETION OF THE WASHINGTON MONUMENT, IN
THE DISTRICT OF COLUMBIA.**

Officer in charge, Lieut-Col. John M. Wilson, Corps of Engineers, Colonel, U. S. Army.

The Executive Mansion has received the usual care, and improvements have been made from time to time as far as the limited appropriation would admit.

The old, decayed wooden water-tank on the roof has been replaced with an iron one holding 2,200 gallons of water, and the Rيدر hot-air engine in the basement, which was worn out, was replaced by a Knowles pumping-engine, and boiler.

The elevator has been thoroughly overhauled and put in good order.

The lighting system was overhauled and maintained in good condition, a critical examination made of the plumbing and sewerage, and considerable improvements made in the plumbing.

The entire floor of the upper corridor was taken up, the floor girders strengthened, and a new floor laid.

The bath-room in the southwest corner, second floor, was separated by a partition from the remainder of the room and improvements made in it, and the main room improved by new flooring, etc.

A number of rooms, halls, etc., were repainted and recalcimined, and a few new articles of furniture, china, bed and table linen purchased.

New matting was placed in the main corridor, red and green parlors, and two bedrooms.

The heating arrangements were overhauled and maintained in good order.

Repairs were made to the stable.

The conservatory and greenhouses were all overhauled and repairs of various kinds made, and a new superstructure was placed upon the greenhouse west of conservatory.

The officer in charge invites attention to the propriety of separating the office of the President from his home, and submits suggestions for consideration.

In addition to the general work performed for maintaining in good condition the improved public reservations, two, heretofore unimproved, have been partially improved, and several only partially improved have been highly improved.

Extensive improvements have been made at the triangular reservation in front of the National Theatre; grounds have been raised, asphalt walks laid, lawns sodded, trees, plants, and shrubs planted, and curbing properly cut and reset.

The high iron fences around Lafayette and Franklin squares have been removed and the parks maintained in excellent condition.

The northwest section of the grounds south of the Executive Mansion has been graded, covered with soil, and seeded; curbing laid, gut-

ters constructed, and a road made south of the State, War, and Navy Building.

Extensive improvements have been made at Judiciary Square, on the north, west, and south fronts of the Pension Building, and the east front has been graded and will be completed at an early day; asphalt walks have been laid, new drains constructed, lawns laid out, and trees and shrubs planted.

In the Smithsonian grounds the area between the two Museum buildings has been graded, lawns made, and roads and paths constructed.

The main asphalt road between Seventh and Twelfth streets has been completed, 1,408 square yards of pavement having been laid, and 1,034 square yards of asphalt paths have been constructed on lines of travel leading to the Museum Building.

At Reservation No. 17, lawns have been laid out and seeded, roads, paths, and gutters constructed, curbing and brick sidewalks laid, and trees and shrubs planted.

Water was introduced into several reservations.

At the Washington Monument improvements were made in the steam-expansion joints and in the lighting arrangements, storm windows and doors introduced, steam-heating pipes placed on lower floor, and thirty-one memorial blocks inserted.

Numerous and extensive repairs were made to the elevator.

The mound around the Monument was completed under contract, as far as delivery of earth was concerned, and operations well advanced grading, soiling, seeding, and preparing to construct roads.

New sewer-pipes were laid at various places for the purpose of draining the grounds.

A granolithic pavement, with curbing and gutter, was laid around the Monument, the outer curbing being the circumference of a circle with a radius of 70 feet, the center being the middle point of the Monument floor.

A handsome white marble lodge has been constructed.

Attention is invited to the detailed report of the officer in charge and to his estimates and recommendations for the fiscal year ending June 30, 1891.

His estimates are as follows:

For improvement and care of public grounds	\$158, 788. 50
For compensation of persons employed on public buildings and grounds.	52, 360. 00
For replacing the overhead system of telegraph wires with duplicate six-conductor underground cable, and for care and repair of existing lines.	10, 000. 00
For contingent and incidental expenses of public buildings and grounds.	500. 00
For care of Washington Monument and maintenance of elevator:	
Salaries of employes	\$8, 400. 00
Fuel, light, contingencies, etc	2, 600. 00
	<hr/>
	11, 000. 00
	<hr/>
	232, 648. 50

(See Appendix A A A.)

CONSTRUCTION AND IMPROVEMENT OF ROADS AND BRIDGES IN YELLOWSTONE NATIONAL PARK.

The beginning of systematic construction of roads and bridges in the Yellowstone National Park followed an appropriation made by act of Congress approved March 3, 1883, the portion of the appropriation allotted to construction work to be expended under the supervision and direction of an Engineer officer to be detailed by the Secretary of War.

This work has remained, since 1883, under the supervision of the Engineer Department.

The condition of the roads and bridges in the Park prior to the adoption in 1883 of a systematic project was as bad as could be. The roads, few in number and generally short, were mere wagon trails; the grades were frequently excessively steep, and the roads full of stumps, rocks, boggy places, and dangerous side-hill slants. The few bridges were of weak and cheap construction, and the crossings of the streams generally had to be made at fords, which at time of high water were impassable.

The project for this improvement, adopted in 1883, and continued to the present time with variation only as to location and detail of work, consists in repairing old trails and in the construction of substantial roads about 18 feet in width, well crowned, ditched, and drained, and, where necessary, to be covered with gravel or broken rock; also the building of good bridges across the streams. The permanent roads to comprise a circuit of about 145 miles, extending from the Park line at Gardiner, Mont., to the Mammoth Hot Springs, thence to Norris Geyser Basin, thence to Upper Basin, thence to Yellowstone Lake *via* Shoshone Lake, across the continental divide of the Rocky Mountains, thence along the Yellowstone Lake and River *via* the Falls and the Grand Cañon to Yancey's, thence to Mammoth Hot Springs. In addition a cross-road from the west line of the Park to Lower Basin and Fire-Hole, thence to the Falls of the Yellowstone; a cross-road from the latter to Norris; a road from Yancey's to the east line of the Park, and a number of short branch roads and trails from the above-named roads to minor objects of interest off the main lines of travel; in all, about 225 miles of new road, about twenty large and fifty small bridges, and many culverts contemplated in the project.

The cost of completing the project was estimated in the Annual Report, 1887, as \$250,000. Recent revised estimates, however, place the cost of completion as \$260,000, in addition to the appropriations and allotments already made.

Total expended from commencement of work in 1883 to the close of the fiscal year ending June 30, 1888, \$134,779.42.

The work performed, 1883-1888, was as follows:

Miles of new road built.....	52
Miles of new road repaired and maintained.....	52
Miles of original wagon roads and trails repaired.....	63.5
Number of large and small bridges built.....	17

Expended during the fiscal year ending June 30, 1889, \$25,000.

Work performed during the year:

Miles of new road built.....	7
Miles of new road repaired and maintained.....	52
Miles of old wagon roads and trails repaired.....	57.5
Miles of wagon trail through Madison Cañon, reopened and made available for travel.....	2
Number of bridges built.....	4
Number of bridges repaired.....	5

The road distances above given are from odometer measurements made in May and June, 1889.

The 7 miles of road built were distributed as follows: between Gardiner and Mammoth Hot Springs, to replace a steep and dangerous piece of road; completion of road from Norris to the Grand Cañon and site, at that locality, of the new hotel; about one mile in Swan Lake Flats; and continuation of the road down Gibbon Cañon to cut off the steep and exceedingly dangerous portions of the existing road between

Norris and Lower Geyser Basin. This last named road had, by the close of the year, nearly reached Gibbon Falls.

In addition to the aggregate of work noted above as done since the commencement in 1883, may be mentioned the construction of culverts, parapets, railings, and repairs to old roads since abandoned. The details are given in the report of the officer in charge.

The appropriation of \$50,000 by act approved March 2, 1889, will be applied to continuation of the Gibbon Cañon Road, to opening and completing, so far as funds will admit of, a road from Upper Basin to and around Shoshone Lake, thence across the continental divide to the west arm of Yellowstone Lake, thence along the lake and river to Grand Cañon, and in general repairs.

The sum of \$120,000, estimated for the fiscal year ending June 30, 1891, to be expended in completing the road from Upper Basin to and around Shoshone Lake, thence across the divide to and along Yellowstone Lake and River, thence to the Grand Cañon, thence to Yancey's to intersect the road from Cook City to Mammoth Hot Springs, in completing Gibbon and Madison Cañon routes, in improving and maintaining the old road from Lower Basin and Fire-Hole to the Falls of the Yellowstone, in maintaining roads and bridges generally throughout the Park, and in making some small extensions to existing roads; also in purchasing a portable rock-crusher and in erecting a dwelling and warehouse for engineer purposes.

The officer in charge submits an estimate of \$25,000 for explorations and surveys from which to project an engineer road-map, the necessity for which is stated in his report.

Owing to the late date at which appropriations are frequently made, the season when expenditures can be made to the best advantage is lost for the fiscal year; for that reason, in order that the work may be done at the most favorable time, it is earnestly recommended that future appropriations be made without limit, as in the case of each of the items of river and harbor acts. The interest of the work would also be greatly advanced, and economy subserved, were the appropriations placed on the footing of those for rivers and harbors, by making them expendible under rules and regulations to be prescribed by the Secretary of War, the work to be done by contract or otherwise, as might be most economical and advantageous to the Government.

Amount appropriated by act approved October 2, 1888	\$25,000.00
Amount appropriated by act approved March 2, 1889	50,000.00
	<hr/> 75,000.00
July 1, 1889, amount expended during fiscal year, exclusive of	
liabilities outstanding July 1, 1888	\$14,739.24
July 1, 1889, outstanding liabilities	10,260.76
	<hr/> 25,000.00
July 1, 1889, balance available	50,000.00
{ Amount (estimated) required for completion of existing project	260,000.00
{ Amount that can be profitably expended on roads and bridges in fiscal	
year ending June 30, 1891	120,000.00
{ Amount that can be profitably expended on survey in fiscal year ending	
June 30, 1891	25,000.00
(See Appendix B B B.)	

PRINTING AND DISTRIBUTION OF CHARTS OF THE NORTHERN AND NORTHWESTERN LAKES.

Under the supervision of this office additions have been made to the engraved copper-plate of chart of Sand Beach Harbor of Refuge, Lake

Huron, and corrections on the engraved plate of chart No. 2, river St. Marie.

During the year 9,521 charts were issued under the supervision of Col. O. M. Poe, Corps of Engineers, 2,073 of which were sold at 30 cents each, and the amount, \$621.90, turned into the Treasury.

Owing to changes in channels, the discovery of previously unknown dangers, and the extension of works of river and harbor improvement, many of the charts require additions and corrections in order to render them of the greatest service. In some cases limited surveys will be required to obtain the requisite data. Considering the extensive use made of the charts and their recognized value to the lake marine, it is recommended that the sum of \$10,000 be annually appropriated for the purpose of making the necessary surveys and for correcting the engraved plates, in addition to the amount appropriated for electrotyping the plates and for chart printing. The recommendations of the last two years are repeated in this respect.

Amount allotted from act approved October 2, 1888	\$1,332.08
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$442.08
July 1, 1889, outstanding liabilities	290.00
	<u>1,332.08</u>

{ Amount that can be profitably expended in fiscal year ending June 30, 1891 13,000.00
 { Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix C C C.)

MILITARY AND GEOGRAPHICAL MAPS.

A map of that portion of the Department of the Platte and adjacent territory west of the 103d meridian has been photolithographed and an edition printed and distributed.

A map of the Mississippi River from the Falls of St. Anthony to the junction of the Illinois River, in 27 sheets, scale 1 inch to 1 mile, has also been photolithographed and printed.

SURVEY OF ROAD FROM THE AQUEDUCT BRIDGE TO MOUNT VERNON, VIRGINIA.

Lient. Col. Peter C. Hains, Corps of Engineers, in charge.

Congress, by act approved February 23, 1889, authorized the Secretary of War to cause surveys to be made for a national road from a point at or near the Virginia end of the Aqueduct Bridge to Mount Vernon, a report on the same to be made to Congress, together with an estimate of the cost of building such a road. Ten thousand dollars was appropriated to defray the expenses of the survey.

The work was assigned to the charge of Lieutenant-Colonel Hains in March, 1889. That officer reports that the work on that section of country lying between the Aqueduct Bridge and Hunting Creek was about completed at the close of the fiscal year.

Amount appropriated by act of February 23, 1889	\$10,000.00
July 1, 1889, amount expended during fiscal year	\$1,228.10
July 1, 1889, outstanding liabilities	1,298.44
	<u>2,526.54</u>
July 1, 1889, balance available	7,473.46

(See Appendix D D D.)

EXAMINATION OF HISTORIC GROUNDS, LOCATIONS, AND MILITARY WORKS IN THE MAUMEE VALLEY.

Congress, by act approved May 24, 1888, appropriated \$150 for the purpose of making, by an officer of the Engineer Corps, in co-operation with the Maumee Valley Monumental Association, an examination of certain named historic grounds, locations, and military works therein enumerated.

This duty was assigned to Col. O. M. Poe, Corps of Engineers, whose report upon the results of the examinations, inspections, and surveys, together with maps accompanying the same, were transmitted to Congress and printed as House Ex. Doc. No. 28, Fiftieth Congress, second session.

The amount of grounds necessary for the protection and improvement of the works, forts, battle-fields, and burial places mentioned in the above act is reported upon, and Colonel Poe submits the following estimates of cost of proposed improvement of each of the seven localities provided for:

For Put-in-Bay	\$2,500
For Fort Industry	5,000
For Fort Miami	7,500
For Fort Meigs	30,500
For battle-field of Fallen Timber	5,000
For Fort Defiance	5,000
For Fort Wayne	5,000
Total	60,500

(See Appendix E E E.)

RECONNAISSANCES AND EXPLORATIONS.

The following officers have been on duty at the headquarters of the military divisions and departments, engaged in preparing such maps and making such surveys as were required by their respective commanding officers:

Capt. William L. Marshall, Corps of Engineers, at headquarters Division of the Missouri.

Lieut. Fayette W. Roe, Third U. S. Infantry, at headquarters Department of the Platte.

Lieut. Leonard A. Lovering, Fourth U. S. Infantry, at headquarters Department of the Columbia, from August 28, 1888.

Lieut. James E. Runcie, First U. S. Artillery, at headquarters Division of the Pacific.

Capt. William L. Marshall, engineer officer Division of the Missouri, reports that there has been no field work in progress during the year. The office work has consisted in collecting, compiling, and plotting geographical information for the improvement of existing maps; in making reductions and enlargements, and fac-simile copies and tracings of maps of military and Indian reservations, posts, scouts, reconnaissances, etc., for use at those headquarters and elsewhere in the division, for file and forwarding.

During the year monthly reports of operations have been received from the engineer officers of the departments included in that division. Besides these reports these officers are required to forward such special reports and maps of work done as may be useful to the major-general commanding the division.

Twenty-two maps and tracings were drawn during the year, one map mounted, and three issued.

(See Appendix F F F 1.)

Lient. Fayette W. Roe, Third U. S. Infantry, in charge of engineer office, Department of the Platte, reports the preparation and completion, by Lient. Hiram M. Chittenden, Corps of Engineers, of map of portion of the Department of the Platte and adjacent territory west of the 103d meridian; the preparation of a contour map of the Fort McKinney military and wood and timber reservations, from notes and sketches of the survey made by Lieutenant Chittenden, and the usual routine work of issuing instruments and note books, mounting maps, and making tracings and blue-prints.

(See Appendix F F F 2.)

Lient. Leonard A. Lovering, Fourth U. S. Infantry, acting engineer officer, Department of the Columbia, reports the resurvey of Boise Barracks military reservation, sanitary survey of Fort Spokane, resurvey of the eastern boundary of the Vancouver Barracks military reservation, and resurvey of the Fort Klamath military and hay reservations.

Many maps, plans, tracings, solar prints, etc., have been prepared and issued to the officers of the department.

Additions and corrections are constantly being made to the department map to add to its efficiency and perfection.

All available data are being collected for a map of Alaska, which is now under way.

(See Appendix F F F 3.)

Lient. James E. Buncie, First U. S. Artillery, acting engineer officer, Division of the Pacific, reports the following work accomplished:

Continued map of the Department of California; surveyed, leveled, and located line of proposed road on the Presidio reservation; platted and drew profiles and maps of same; made preliminary survey of wagon road at Fort Gaston, Cal.; investigation and report upon water supply and sewerage system of Fort Wingate, N. Mex.; topographical sketch of proposed site for military post on San Carlos Indian Reservation; platted on map of Department of the Columbia the line of march of Troop M, Second Cavalry, from Fort Bidwell to Fort Walla Walla, Wash.; made blue prints of map of march of Light Battery K, First Artillery, and of map of Fort Mason, Cal.; traced map of Fort Grant, Ariz., showing proposed water supply and drainage; surveyed and relocated corner posts for boundaries between the Presidio of San Francisco and the Rancho Ojo de Agua de Figueroa, with report and diagrams; made detail drawings for the construction of drainage, etc., at military posts; drew diagram of position of troops at review held at Presidio, February 22, and plan and section of proposed bath-house for use at military posts; traced map of the seat of the Indian war in Rogue River Valley, Oregon, in 1855; of map of New Dungeness Harbor; of map of scout made by Troop I, Fourth Cavalry; of the mouth of the Columbia River and Admiralty Inlet, and of map of military reservation at Lime Point; made tracings of military reservation at Fort Apache, Ariz., showing water supply; of the Laguna survey; made drawings and tracings of details for water supply, flume, sinks, etc., for Fort Apache; platted quarantine station reservation on existing map of Angel Island, showing its proximity to the long-range targets; surveyed and made profiles for new road at Fort Mason, Cal.; traced maps of proposed defenses of San Francisco Bay, Half Moon Bay, Drake's Bay, San Simeon Bay, Santa Barbara Harbor, and San Pedro Harbor, and traced diagram of the spot where Major Wham, paymaster, was robbed.

(See Appendix F F F 4.)

ESTIMATE FOR AMOUNT REQUIRED FOR SURVEYS AND RECONNAISSANCES IN MILITARY DIVISIONS AND DEPARTMENTS.

For military surveys and reconnaissances and surveys of military reservations by the engineer officers attached to the several headquarters of military divisions and departments, being an average of \$1,875 for each of eight military divisions and departments west of the Mississippi River, \$15,000; for publication of maps for use of the War Department, \$10,000; total, \$25,000.

Attention is specially invited to this estimate for appropriation and to the important uses for which it is intended.

At the headquarters of the military departments west of the Mississippi River there are stationed officers of the Corps of Engineers, or other officers detailed to act, whose duty it is to make reconnaissances for military purposes, to make such surveys and prepare such maps as may be required by their respective commanding officers. In recent years no appropriations have been made for these purposes, and, consequently, these officers have been very much cramped from lack of the necessary means, and the usefulness of their offices has been very much reduced in consequence. The maps of these departments are constantly in need of revisions and additions, which the officers make so far as possible, but with no means even for the purchase of paper their efforts are limited in results.

Paragraph 383 of the Army Regulations requires that the commanding officer of each post where there are fixed batteries bearing upon a channel will call upon the Engineer Department for accurate charts showing the soundings, to the extent of the ranges of the guns. Calls upon this department to perform its duty under this regulation can not be honored from lack of means.

Maps of certain military departments are now being prepared, and should be published.

Besides all this there is much information in this office relative to military geography which could, with little expense, be made available for the information of officers of the Army; for instance, there are on the office files detailed maps of regions of Europe which may become at an early day the theaters of war, and it would be of great advantage to the service if such information as these maps give could be made available for the study of officers, especially on the outbreak of hostilities. Were the means provided, this office would be glad to compile and to disseminate the information on its files.

It is the policy of this country to keep a standing army small in numbers, but it is its expectation that it should be a highly instructed one, and a small outlay as here referred to will be conducive to that end.

Applications from officers of the Army have been received for maps of certain regions of Europe, and it was with great regret that this office could not render this assistance to officers desirous of improving themselves professionally, especially when the material was on its files.

OFFICE OF THE CHIEF OF ENGINEERS.

During the fiscal year ending June 30, 1889, the following-named officers were in charge of the several divisions of the Office of the Chief of Engineers:

FIRST DIVISION.—*Fortifications and Surveys relating thereto—Armament of Fortifications—Sites for Engineer Defenses—Boards of Engineers for Defenses—Public Buildings and Grounds and Washington Aqueduct.*

SECOND DIVISION.—*Battalion of Engineers—Engineer School of Application and Engineer Depot and Post—Professional Papers and Information—Personnel—Orders—Military Reservations—Land Files.*

Capt. Clinton B. Sears.

THIRD DIVISION.—*Improvement of Rivers and Harbors and Surveys relating thereto—Bridging Navigable Waters of the United States.*

Maj. James C. Post, until March 18, 1889, since which date Maj. Henry M. Adams.

FOURTH DIVISION.—*Accounts for Disbursements—Contracts—Returns of Engineer Property and Instruments—Applications for Remittances—Appropriations and Estimates—Blank Forms.*

FIFTH DIVISION.—*Survey of the Lakes—Explorations and Surveys—Reconnaissances—Maps—Instruments—Claims.*

Capt. Thomas Turtle.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

**STATEMENT SHOWING THE RANK AND THE DUTIES OF OFFICERS OF
THE CORPS OF ENGINEERS DURING THE FISCAL YEAR ENDING JUNE
30, 1889.**

RANK AND NAME.	DUTIES.
BRIGADIER-GENERAL AND CHIEF OF ENGINEERS.	
Thos. Lincoln Casey	<p>In command of the Corps of Engineers and in charge of the Engineer Department. Charged with the supervision of such matters connected with construction of jetties and other works at South Pass, Mississippi River, as require the action of the Secretary of War. In charge of the construction of the building for Library of Congress under act of October 2, 1888. Member of Joint Commission to supervise the construction of the Washington National Monument. Member of the Light-House Board. Member and President of the Board of Engineers. Member of Board of Visitors for Engineer School of Application at Willets Point, N. Y.</p>
COLONELS.	
John G. Parke.....	<p>Detached; Superintendent of the Military Academy until June 24, 1889, when the duties were relinquished.</p>
<i>Bvt. Major-General.</i>	
George H. Mendell.....	<p>Division Engineer of the Pacific Division. In charge of the defensive works at Alcatraz Island, at Lime Point, Fort Winfield Scott, and Battery at Fort Mason, in San Francisco Bay; and of the Battery at San Diego, Cal. In charge of the improvement of the harbors at Oakland and Redwood, Cal. In charge of the improvement of Napa River, Cal. To investigate causes tending to decrease depth of water and diminish the commercial value of San Francisco Harbor. In charge of survey of San Francisco Harbor, San Pablo and Suisun bays, Strait of Carquinez, and mouths of San Joaquin and Sacramento rivers, Cal. Detailed to act in conjunction with Colonel Shafter and Surgeon Sawtelle for the purpose of establishing the boundary lines of, and transferring a portion of, the military reservation of Angel Island, Cal., to the Treasury Department, for temporary use as a quarantine station in San Francisco Harbor. Member of Boards of Engineer Officers on improvement of Coos and Yaquina bays, Oreg.; on obstructions to navigation in the Columbia River at The Dalles and Celilo Falls, and at Three and Ten Mile Rapids; and to establish the harbor lines of San Francisco and San Diego harbors and adjacent waters, Cal. Absent in Europe under orders from Secretary of War.</p>
Henry L. Abbot	<p>Division Engineer of the Northeast Division. Member and President of the Board of Engineers. In charge of certain experiments with torpedoes. Member of Board of Visitors for Engineer School of Application at Willets Point, N. Y. Member of Board of Ordnance and Fortification. Member of Boards of Engineer Officers to consider the matter of the harbor lines of the port of Boston; to establish the harbor lines of New York Harbor and its adjacent waters; on further improvement of the harbors of St. Augustine and Key West, Fla.; and for examination of certain named officers of the Corps of Engineers with view to their promotion.</p>
<i>Bvt. Brig. General.</i>	

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
COLONELS. (continued.)	
William P. Craighill....	Division Engineer of the Southeast Division. Member of the Board of Engineers. In charge of the defensive works at Forts Carroll and McHenry, Baltimore, Md. In charge of the improvement of the harbors at Baltimore and Annapolis, Md. In charge of harbor of refuge at mouth of Great Kanawha River, W. Va. In charge of the improvement of James River, Va., and New River, Va. and W. Va., and Gauley, Great Kanawha, and Elk rivers, W. Va. In charge of the examination, survey, and estimate of cost of diverting water of Appomattox River above harbor at Petersburg to the old North Channel, Va. In charge of preliminary examination of Hampton Creek and Bar, Hospital Point, and Chuckatuck and Bennett's creeks, Va. In temporary charge of the improvement of the harbor at Norfolk, and the approach to Norfolk Harbor and the United States navy-yard, Va. In temporary charge of the improvement of the Blackwater, Nottoway, Archer's Hope, Appomattox, and Nansemond rivers, including mouth of Bennett's and Chuckatuck creeks, Va., and Meherrin River, Currituck Sound, Coanok and Edenton bays, and North River Bar, N. C., and North Landing River, Va. and N. C. Member of Boards of Engineer Officers on improvement of the Potomac River in the vicinity of Washington, D. C.; on subject of permanent improvement of Delaware River and Bay; on improvement of Charleston Harbor, S. C.; on improving Cumberland Sound and Savannah River below Savannah, Ga.; on obstructions to navigation in the Columbia River at The Dalles and Celilo Falls and at Three and Ten Mile Rapids; to establish the harbor lines of New York Harbor and its adjacent waters; of the port of Philadelphia; of Norfolk and Portsmouth harbors and their adjacent waters; of Savannah Harbor; and of Brunswick Harbor. Member of Court of Inquiry upon the lining of the tunnel extension of the Washington Aqueduct. Member of Advisory Board to State Harbor Commission of Norfolk, Portsmouth, and Norfolk County, Va. Absent in Europe under orders from the Secretary of War.
Cyrus B Comstock..... <i>Act. Brig. General.</i>	Division Engineer of the Southwest Division. Member of the Board of Engineers. Member of the Board of Visitors for Engineer School of Application at Willets Point, N. Y. Member and President of the Mississippi River Commission created by Act of Congress approved June 28, 1879. Member of Boards of Engineer Officers on improvement of the Potomac River in vicinity of Washington, D. C.; on improvement of Winyaw Bay, S. C.; to establish the harbor lines of New York Harbor and its adjacent waters; to establish the harbor lines of the Port of Philadelphia; and on bridge across the Ohio River between Jeffersonville, Ind., and Louisville, Ky. Member of General Court-Martial convened at Washington on March 25, 1889.
Orlando M. Poe..... <i>Act. Brig. General.</i>	Division Engineer of the Northwest Division. In charge of the defensive works at Fort Wayne, Mich. In charge of the improvement of the harbors at Cheboygan, Au Sable, and at Thunder Bay; harbor of refuge at Sand Beach; of the St. Mary's River, at the falls; of the St. Clair Flats Ship Canal; and of the rivers Detroit, Saginaw, Clinton, and Rouge, and mouth of Black River, Mich., and Hay Lake Channel of the St. Mary's River;

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
<p>COLONELS. (continued.)</p>	<p>of removing bar at ice harbor of refuge at Belle River, Mich., construction of dry dock, St. Mary's Falls Canal, and of dredging at Grosse Pointe Channel. In charge of St. Clair Flats Ship Canal and St. Mary's Falls Canal, Mich. In charge of issuing charts of Northern and Northwestern Lakes, and of water-level observations on Lake Huron. In charge of survey of historic grounds, etc., referred to in the Act of Congress approved May 24, 1888. In charge of preliminary examination of False Presque Isle Harbor, Lake Huron, for a harbor of refuge; Au Gres River to Au Gres; Detroit River at Gross Point; Thunder Bay River, Alpena; Au Sable River at Au Sable, Port Austin, Lexington, and Forestville, for breakwater; Black River at Port Huron; Pine River at St. Clair City; Quanicassaw River; Port Sanilac for harbor of refuge; and Algonac on St. Clair River with view of uniting north and south channels between Clark and Harsens islands, Mich. In charge of survey of Detroit River at Gross Point; Thunder Bay River, Alpena; and Black River at Port Huron, Mich. To supervise and personally examine the construction of bridge across the west channel of the Detroit River to connect Belle Isle Park with the mainland, and to supervise the construction of Embankment Dam on the rapids of the St. Mary's River between the mainland and Island No. 3. Member of the Boards of Engineer Officers on improvement of navigation of Rock Island Rapids, Mississippi River; and on bridge across the Detroit River at Detroit, Mich. Member of General Court-Martial convened at Washington on March 25, 1889.</p>
<p>LIEUTENANT-COLONELS.</p>	
<p>David C. Houston <i>Bvt. Colonel.</i></p>	<p>Member of the Board of Engineers in charge of the defensive works at Forts Griswold, Trumbull, and Hale, Conn., Lafayette, Columbus, Wood, Wadsworth, and Tompkins, and its batteries, N. Y.; Castle Williams, South Battery, New Barbette Battery at Governor's Island, N. Y.; of sea-wall at same; of sea-wall and embankment at David's Island, N. Y.; and of permanent platforms for modern cannon of large caliber. In charge of the improvement of the harbors of New London, Clinton, New Haven, Milford, Bridgeport, Black Rock, Southport, Stamford, Five Mile River, and Norwalk, Conn., and Port Jefferson, Greenport, Mamaroneck, Port Chester, New Rochelle, Glen Cove, and of Echo Harbor, N. Y., and of the construction of breakwater at New Haven, Conn. In charge of the improvement of the rivers Housatonic and Thames, Conn., Connecticut, Mass. and Conn., Flushing Bay, and East Chester Creek, N. Y. In charge of the manufacture and supply of Mastic. In charge of preliminary examinations of Mystic River; New London Harbor; Black Rock Harbor for breakwater to Pentfield Reef and south from Fairweather Island, Conn.; Fort Pond Harbor, Montauk; Brown's Creek, Sayville; Port Jefferson Inlet, and Larchmont Harbor, N. Y. In charge of survey of Larchmont Harbor and of Brown's Creek, N. Y. In charge of removal of the remaining pieces of wreck of steamer <i>Bay Ridge</i> from channel leading to Hempstead Harbor, N. Y. Member of Boards of Engineer Officers on improvement of Winyaw Bay, S. C.; and to establish the harbor</p>

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
LIEUTENANT-COLONELS. (continued.)	
George H. Elliot Henry M. Robert	<p>lines of New York Harbor and its adjacent waters. Member of Board of Visitors for Engineer School of Application at Willets Point, N. Y.</p> <p>On sick leave of absence.</p> <p>In charge of the defensive works at Fort Mifflin, Pa.; Fort Delaware, and fort opposite Fort Delaware, Del.; at Finn's Point, and site for defenses at Red Bank, N. J. In charge of the improvement of the harbors at Philadelphia and Delaware Breakwater; ice-harbors at Marcus Hook, Pa., and the head of Delaware Bay, of the Salem, Rancocas, and Raccoon Rivers, and Cohansey, Mantua, and Woodbury creeks, N. J.; Frankford Creek and Schuylkill River, Pa.; and Delaware River, from Trenton, N. J., to its mouth; and Mantua Creek, N. J.; and of the construction of pier near Lewes, Del. In charge of preliminary examination of Alloway and Little Salem creeks, N. J. In charge of survey of Alloway Creek, N. J. In charge of removal of wreck of schooner <i>Sallie C. Morton</i> off Cape May; of wreck of schooner <i>Lizzie</i> at the mouth of English Creek, N. J. Member of Boards of Engineer Officers on subject of permanent improvement of Delaware River and Bay; on improvement of Winyaw Bay, S. C.; and to establish the harbor lines of the Port of Philadelphia, and of "Surveys for Deep Water Harbor, Gulf of Mexico." Member of Commission Advisory to Board of Harbor Commissioners of Philadelphia. Member of General Court-Martial convened at Washington on March 25, 1889.</p>
William E. Merrill <i>Bvt. Colonel.</i>	<p>In charge of the improvement of the Ohio River, Monongahela River, W. Va., Allegheny River, Pa., and of the Muskingum River, Ohio. In charge of the construction of harbors of refuge at mouth of Muskingum River, near Cincinnati, Ohio, and of a dam at Herr's Island, Pa. In charge of the negotiations for the purchase of the "Upper Lock and Dam," etc., of the Monongahela Navigation Company, Pa., and W. Va. In charge of preliminary examination of Muskingum River from Zanesville to Dresden, Ohio; Cheat River, and Monongahela River above upper dam, W. Va., and of Harbor at Owensborough, Ky. In charge of removal of wrecks of two barges from the Ohio River, at Glasshouse Ripple, near Pittsburgh, Pa. To exercise supervision over the construction of bridges across the Ohio River between Covington and Cincinnati; at Cairo; between Cincinnati and Newport; between Wheeling, W. Va., and Martin's Ferry, Ohio; near the mouth of Cork's Run, in Allegheny County, Pa., and over Muskingum River, at Stockport, Ohio. Member of Boards of Engineer Officers on proposed bridge across the Ohio River at Louisville, Ky.; on proposed bridge across the Mississippi River, at Memphis, Tenn.; on improving the Ohio River below Pittsburgh by means of movable dams; and on improvement of Indiana Chute and the Falls of the Ohio at the head of the Louisville and Portland Canal. Member of General Court-Martial convened at Washington on March 25, 1889. Engineer 14th Light-house District.</p>
John M. Wilson <i>Bvt. Colonel.</i>	<p>In charge of Public Buildings and Grounds in the District of Columbia, with the rank of Colonel. In charge of the Washington Aqueduct; increasing water supply of the city of Washington; and the erection of fish-ways at Great Falls of the Potomac River. In charge of the im-</p>

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
LIEUTENANT-COLONELS. (continued.)	
John W. Barlow.....	<p>provements over the grave of Thomas Jefferson, at Monticello, Va.; of the erection of a monument at Washington's Headquarters at Newburgh, N. Y.; of the erection of a monument to mark the birthplace of George Washington; of the erection of building for the Army Medical Museum and Library, and of the erection of monuments or memorial tablets for the proper marking of the position of each of the commands of the Regular Army engaged at Gettysburgh. In charge of the completion, care, and maintenance of the Washington Monument. In charge of increasing the water supply of Executive Mansion. Member of Board of Engineer Officers on obstructions to navigation in the Columbia River at The Dalles and Celilo Falls, and at Three and Ten Mile Rapids. Member of the Light-House Board.</p> <p>In charge of the improvement of the rivers Tennessee, Tenn., Ala., and Ky.; Cumberland above and below Nashville, Ky. and Tenn., Hiwassee, Caney Fork, Duck, French Broad, Clinch, and Little Tennessee, Tenn.; and South Fork of the Cumberland, Ky. In charge of preliminary examination and survey of Lower Cumberland River from Nashville to mouth, Tenn. To exercise supervision over the construction of bridge across the Tennessee River at or near Chattanooga, Tenn.</p>
Peter C. Hains.....	<p>In charge of the defensive works at Forts Foote and Washington, Md., Wool and Monroe, Va. In charge of the improvement of the Potomac River at Washington, D. C.; the establishment of the harbor lines, and the raising of the river flats. In charge of the improvement of the Shenandoah River, W. Va. In charge of preliminary examination of Eastern Branch of Potomac River, Md.; Great Cacapan and South Branch of the Potomac River, W. Va. In charge of purchase and reconstruction of Aqueduct Bridge, D. C. In charge of the construction of bridge across the Eastern Branch of Potomac River, D. C.; of bridge across Mill Creek; of a new wharf and of the sewerage system of Fort Monroe, Va. In charge of survey of a road from the Aqueduct Bridge to Mount Vernon. To test samples of cement offered for use of Congressional Library building. Member of Boards of Engineer Officers on further improvement of the harbors of St. Augustine and Key West, Fla., and to establish the harbor lines of Norfolk and Portsmouth harbors and their adjacent waters.</p>
George L. Gillespie.....	<p>Member of the Board of Engineers. In charge of the defensive works at Forts Warren, Winthrop, Standish, Andrew, Independence, and on Long Island Head, Mass.; Fort Hamilton, N. Y., and of fort at Sandy Hook, N. J. In charge of the improvement of the harbors at Newburyport, Lynn, Boston (including sea-walls on Point Allerton, Great Brewster Island, Lovell's Island, Gallop's Island, Long Island Head, Rainsford Island, and Deer Island; Malden, Mystic and Charles rivers, and channel leading to Nantasket Beach), Provincetown, Plymouth, Scituate, Hingham, Gloucester, Winthrop, Wellfleet, and Manchester, Mass.; New York, Rondout, and Saugerties, N. Y. In charge of construction of a national harbor of refuge (of the first class) at Sandy Bay, Cape Ann, Mass. In charge of the improvement of the rivers Merrimac, Ipswich, and Powow, Mass; the Hudson and Harlem rivers,</p>

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
LIEUTENANT-COLONELS. (continued.)	<p>N. Y.; Raritan Bay, N. J.; channel in Gowanus Bay and Buttermilk Channel; deepening Godney's Channel and Newtown Creek and Bay, N. Y. In charge of preliminary examination of Cohasset Harbor; Weymouth River; Goose Point Channel; Plymouth Harbor to public wharf at Kingston; Weir River; Salem Harbor, including South River; Beverly Harbor; Cranes and Waters rivers of Essex Branch; Stage Harbor at Chatham; and Malden River, Mass. In charge of resurvey of public land at Sandy Hook, N. J. In charge of survey for a ship channel between Jersey City and Ellis Island, N. Y.; of survey of Bushwick Creek; Wappinger's Creek, from Wappinger's Falls to its mouth; and of East River, with view to the removal of a ledge of rocks in the same, from foot of Broome street to the foot of Twenty-third street, in New York City, N. Y. In charge of the removal of obstructions in East River and Hell Gate, N. Y. In charge of removal of wrecks of schooners <i>Mary</i> and <i>Goldsmith Maid</i> from Boston Harbor, Mass.; and of wreck of steamship <i>Atlas</i> from the Hudson River at New York city. To mark the boundaries of the military reservation of Fort Sewall, Mass., with suitable monuments. To exercise supervision over construction of proposed bridge across the East River between the city of New York and Long Island. Member of Boards of Engineer Officers on subject of permanent improvement of Delaware River and Bay; for the examination of certain named officers of the Corps of Engineers, with view to their promotion; on improvement of Charleston Harbor, S. C.; on improving Cumberland Sound and Savannah River below Savannah, Ga.; to consider the matter of the harbor lines of the port of Boston; to establish the harbor lines of New York Harbor and its adjacent waters; and on "surveys for deep-water harbor, Gulf of Mexico." Member of Board of Visitors for Engineer School of Application at Willets Point, N. Y. Member of General Court-Martial convened at Washington on March 25, 1889.</p> <p>Charles R. Suter..... Member of the Mississippi River Commission, created by act of Congress approved June 23, 1879. Member and president of the Missouri River Commission, created by act of Congress approved July 5, 1884. To exercise supervision over the construction of bridges across the Missouri River at or near Sioux City, Iowa; opposite to or within the corporate limits of Nebraska City, Nebr.; between the cities of Omaha, Nebr., and Council Bluffs, Iowa; and between Kansas City and Sibley, Mo. Member of Boards of Engineer Officers on the proposed bridge across the Ohio River between Jeffersonville, Ind., and Louisville, Ky., and on bridge across the Mississippi River at La Crosse, Wis. Engineer fifteenth and sixteenth Light-house districts.</p> <p>Jared A. Smith..... In charge of the defensive works at Forts Knox, Popham, Gorges, Scammel, Preble, and McClary; batteries at Portland Head and Gerrish's Island, Me., and at Fort Constitution and Jerry's Point, N. H. In charge of the improvement of the harbors at Bangor, Belfast, Camden, Rockport, Rockland, Portland, and York, Me., Portsmouth, N. H., harbor of refuge at Little Harbor, N. H., and the construction of breakwater from Mount Desert to Porcupine Island, Me. In charge of the improvement</p>

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
LIEUTENANT-COLONELS. (continued.)	
Samuel M. Mansfield.....	<p>of the rivers Penobscot, Kennebec, Saco, Narraganset, Bagaduce, and Kennebec, Me., Cocheco and Bellamy, N. H., Saco River Breakwater, Lubec Channel, Moose-a-bec Bar, and Back Cove, Portland Harbor, Me. In charge of survey of St. Croix River; preliminary examination of Monhegan Island Harbor; Belfast Harbor; harbor and channel at Pembroke; Union River and Union River Bay; Harrisseecket, Medomac, and Kennebec Rivers, and Pleasant River from Columbia Falls to its mouth, Me.; Cocheco River from Dover to its mouth, and Hampton River, N. H. In charge of survey of Belfast Harbor; Union River and Union River Bay; St. Croix River; Pleasant River, from Columbia Falls to its mouth, and Kennebec River, Me., and Cocheco River, from Dover to its mouth, N. H. Member of Board of Engineer Officers on "Surveys for deep-water harbor, Gulf of Mexico."</p> <p>In charge of the defensive works at Forts Warren, Winthrop, Standish, Andrew, Independence, and on Long Island Head, Mass. In charge of the improvements of the harbors at Newburyport, Lynn, Boston (including sea-walls on Point Allerton, Great Brewster Island, Lovell's Island, Gallop's Island, Long Island Head, Rainford Island, and Deer Island; Mystic and Charles rivers, and channel leading to Nantasket Beach), Provincetown, Plymouth, Scituate, Hingham, Gloucester, Winthrop, Wellfleet, and Manchester, Mass.; Charlevoix, Frankfort, Manistec, Ludington, Pentwater, White River, Muskegon, Grand Haven, Black Lake, Saugatuck, South Haven, and St. Joseph, and harbor of refuge at Portage Lake, Mich., and harbor at Michigan City, Ind. In charge of construction of a national harbor of refuge (of the first class) at Sandy Bay, Cape Ann, Mass. In charge of the improvement of the rivers Merrimac, Ipswich, and Powow, Mass.; and of St. Joseph River, Mich., from its mouth to Berrien Springs. In charge of preliminary examination of Petoskey Harbor for breakwater and harbor of refuge; Saugatuck Harbor; and Grand River, from Grand Rapids to Lake Michigan, Mich. In charge of survey of Weymouth River; Salem Harbor, including South River; Beverly Harbor; and Waters River of Essex Branch, Mass. In charge of removal of wrecks of schooners <i>Mary</i> and <i>Goldsmith Maid</i> from Boston Harbor, Mass. Member of the Board of Engineer Officers to consider the matter of the harbor lines of the port of Boston. Engineer ninth and eleventh Light-house districts.</p>
William R. King.....	<p>Member of the Board of Engineers. Commanding Post and Engineer School of Application at Willets Point, N. Y., and the Battalion of Engineers. In charge of the defensive work at Fort Schuyler and Willets Point, of the Engineer Depot at Willets Point; torpedoes for harbor defense, and experiments with the same. In charge of funds pertaining to the library of the Engineer School of Application. Member of Boards of Engineer Officers to report upon the "Auto-Mobile Controllable Torpedo," of Mr. J. N. H. Patrick; for the examination of certain named officers of the Corps of Engineers, with view to their promotion; on improvement of Charleston Harbor, S. C.; on improving Cumberland Sound and Savannah River below Savannah, Ga.; on improvement of Buffalo and Erie harbors; and to establish the harbor lines of New York Harbor and its adjacent waters.</p>

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
MAJORS.	
Wm. H. H. Benyaurd....	In charge of the improvement of the harbors at Wilmington, San Diego, and Redwood, and construction of breakwater at San Luis Obispo Harbor, Cal. In charge of examination and survey for establishment of breakwater at San Luis Obispo Harbor, Cal. In charge of preliminary examination of San Buenaventura Harbor and San Simeon Bay, Cal.; Colorado River between Camp Mojave and El Dorado Cañon, and between Camp Mojave and the boundary line between Nevada and Utah Territory, Ariz. In charge of removal of wreck of a lighter from channel of Wilmington Harbor, Cal. In temporary charge of the defensive works at Alcatraz Island, at Lime Point, Fort Winfield Scott, and battery at Fort Mason, in San Francisco Bay, and of the battery at San Diego, Cal.; the improvement of Oakland Harbor and of Napa River, Cal.; survey of San Francisco Harbor, San Pablo and Suisun bays, Strait of Carquinox, and mouths of San Joaquin and Sacramento rivers, Cal. Member of Boards of Engineer Officers to establish the harbor lines of San Francisco and San Diego harbors and adjacent waters; and on the mining debris question in the State of California, etc.
Garrett J. Lydecker	In charge of the Washington Aqueduct; increasing water supply of the city of Washington, and the erection of fish-ways at Great Falls of the Potomac River.
Amos Stickney	In charge of the Louisville and Portland Canal. In charge of the improvement of the Falls of the Ohio River, the Indiana Chute Fall, Ohio River, Wabash River, Ind. and Ill., and White River, Ind. In temporary charge of the improvement of the Tradewater River, Ky. To exercise supervision over the construction of the bridge across the Tradewater River, and of bridge across the Ohio River at Louisville, Ky. Member of Boards of Engineer Officers on proposed bridge across the Ohio River at Louisville, Ky.; on improving the Ohio River below Pittsburgh by means of movable dams; to examine and report upon the bridge now being constructed across the Green River below Lock No. 1; and on improvement of Indiana Chute and the Falls of the Ohio at the head of the Louisville and Portland Canal.
Alexander Mackenzie..	In charge of the improvement of the Mississippi River from Minneapolis to Des Moines Rapids; the Upper Mississippi River, and Rock Island Rapids and Des Moines Rapids of the Mississippi River. In charge of the construction of a dry-dock at the Des Moines Rapids Canal; of ice-harbor at Dubuque, Iowa, and of harbors of refuge on Lake Pepin at Stockholm, Wis., and Lake City, Minn. In charge of operating the Des Moines Rapids Canal and of operating snag-boats and dredge-boats on Upper Mississippi River. In charge of preliminary examination of Moline City Harbor and Main Slough, Mississippi River, at Hamilton, Ill. In charge of examination and survey of the Mississippi River at Rock Island Rapids, and of the Mississippi River at and near the head of Beaver Island at Clinton, Iowa. In charge of the work in connection with the Adams Flume, Mississippi River. To supervise the work of alteration in the ponton bridge across the Mississippi River at Prairie du Chien, Wis. Member of Boards of Engineer Officers on improving the Ohio River below Pittsburgh by means of movable dams; on im-

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
<p>MAJORS. (continued.)</p>	<p>provement of navigation at Rock Island Rapids, Mississippi River; on improvement of Indiana Chute and the Falls of the Ohio at the head of the Louisville and Portland Canal; to establish the harbor lines in Quincy Bay, Ill.; and on bridge across the Mississippi River at La Crosse, Wis. Member of the Missouri River Commission created by act of Congress approved July 5, 1884.</p>
<p>Oswald H. Ernst</p>	<p>In charge of the improvement of the entrance to Galveston Harbor and of the harbor at Brazos Santiago, Tex. In charge of the improvement of ship channel in Galveston Bay, Pass Cavallo, Aransas Pass and Bay up to Rockport and Corpus Christi, mouth of Brazos River, Buffalo Bayou, and Trinity River, Tex. In charge of preliminary examination of Rio Grande River from Embudo, N. Mex., to El Paso, Tex.; for removal of raft on Guadalupe River; mouth of Caney Creek where it empties into Matagorda Bay; and for removal of bar at mouth of Cedar Bayou where it empties into Galveston Bay, Texas. In charge of survey for removal of bar at mouth of Cedar Bayou where it empties into Galveston Bay, Tex. Member of Board of Engineer Officers on proposed bridge across the Mississippi River at Memphis, Tenn. Member of the Mississippi River Commission created by act of Congress approved June 28, 1879. Member of the Missouri River Commission created by Act of Congress approved July 5, 1884. On duty connected with the Department of State at El Paso, Tex., temporarily.</p>
<p>David P. Heap</p>	<p>Detached; Engineer third Light-house District.</p>
<p>William Ludlow</p> <p><i>Bvt. Lieut. Colonel.</i></p>	<p>In charge of the improvement of the harbors at Frankfort, Manistee, Pentwater, White River, Muskegon, Grand Haven, Black Lake, Saugatuck, South Haven, St. Joseph, and Charlevoix, and entrance to Pine Lake, and harbors of refuge at Ludington and Portage Lake, Mich., and harbor at Michigan City, Ind. In charge of the improvement of St. Joseph River, Mich., from its mouth to Berrien Springs. In charge of survey of Petoskey Harbor, Mich. Engineer fourth, ninth, and eleventh Light-house Districts.</p>
<p>William A. Jones</p>	<p>In charge of the improvement of the Upper and Lower Columbia and Snake rivers, Oregon and Wash.; Willamette River above Portland, and Lower Willamette River below Portland, Oregon; Cowlitz River, Wash., and Yamhill River, Oregon. In charge of the preliminary examination of Upper Columbia River between Wallula and British Line, and of North Palouse River, Wash. In charge of survey of Upper Columbia River between Wallula and British Line. To supervise the construction of bridge across the Snake River, near Texas Ferry, Wash. Member of Board of Engineer Officers on improvement of Coos and Yaquina bays, Oregon.</p>
<p>Andrew N. Durrell</p>	<p>In charge of the defensive works at Forts Morgan and Gaines, Ala., and fort on Ship Island, Miss. In charge of the improvement of the harbor at Mobile, Ala. In charge of the improvement of the rivers Warrior and Black Warrior, Ala.; Pascagoula, Pearl, and Noxubee, Miss.; Tombigbee, Ala. and Miss., the roadstead leading into Back Bay of Biloxi in Mississippi Sound, channel of Biloxi Bay, and Old Town Creek, Miss. In charge of survey of Tombigbee River from Vienna, Ala., to Walker's Bridge, Miss. In charge of preliminary examination of Warrior River from Tuscaloosa to Demopolis; Sipsey</p>

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
<p>MAJORS. (continued.)</p> <p>Charles J. Allen.....</p>	<p>River from the Tombigbee River at Vienna to Texas, Ala.; Gulf Port Harbor; Leaf River from its mouth to mouth of Bowie Creek; Chickasahay River from its mouth to Enterprise; Bluff Creek from its mouth to the head of navigation; and Tombigbee River between Vienna and Cotton Gin, Miss. In charge of preliminary examination and survey of Bogue Chitta River, La. To exercise supervision over the construction of bridge across Tombigbee River at Waverly, Miss.</p> <p>In charge of the improvement of the Chippewa River and protection of Yellow Banks on the same; of the Minnesota and St. Croix rivers, and the Red River of the North; of the Mississippi River above the Falls of St. Anthony; of the Falls of St. Anthony; construction of Meeker's Island lock and dam, and lock and dam at Goose Rapids on Red River of the North. In charge of the improvement of the Yellowstone River, Mont. and Dak., and the Missouri River from Sioux City, Iowa, to Fort Benton, Mont. In charge of construction and improvement of roads and bridges in Yellowstone National Park. In charge of the construction of reservoirs at headwaters of the Mississippi River and its tributaries. In charge of the examination and surveys of the sources of the Mississippi, St. Croix, Chippewa, and Wisconsin rivers, with the view to ascertaining the practicability and cost of creating and maintaining reservoirs, etc. In charge of preliminary examination of ice-harbor at or near Bismarck, Upper Missouri River, Dak. To exercise supervision over construction of bridges across Red River of the North at Alpha, De Mers, and Minnesota avenues, Grand Forks, Dak. Member of Boards of Engineer Officers to establish the harbor lines in Marquette Harbor; on bridge across the Detroit River at Detroit, Mich.; and on the proposed bridge across the Ohio River between Jeffersonville, Ind., and Louisville, Ky.</p>
<p>Charles W. Raymond...</p>	<p>Detached; Engineer Commissioner of the District of Columbia.</p>
<p>L. Cooper Overman.....</p>	<p>In charge of the improvement of harbors at Monroe, Mich., Toledo, Port Clinton, Sandusky, Vermillion, Huron, Rocky River, Cleveland, Fairport, Ashtabula, Conneaut, and mouth of Black River, Ohio. In charge of improvement of Sandusky River, Ohio. In charge of preliminary examination of Monroe Harbor, Mich.; Conneaut Harbor; Cowles Creek or Geneva; and mouth of Chagrin River, near Willoughby, Ohio. In charge of water-level observations on Lake Erie. In charge of removal of wreck of schooner <i>Joy</i> from Ashtabula Harbor, Ohio. Member of Board of Engineer Officers on improvement of Buffalo and Erie harbors. Engineer tenth Light-house District.</p>
<p>Alexander M. Miller.....</p>	<p>In charge of the improvement of the rivers Mississippi and Missouri—removal of snags, etc.; Mississippi River between the mouths of the Illinois and Ohio rivers; Osage and Gasconade rivers, Mo. In charge of preliminary examination of St. Louis Harbor, Grand River and Missouri River at Miami, Mo. In charge of survey of Osage River, with a view to constructing locks and dams, Mo. To exercise supervision over the construction of bridge across the Mississippi River at St. Louis, Mo. To examine and report on the question of the water supply for the port of</p>

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

NAME AND RANK.	DUTIES.
<p>MAJORS. (continued.)</p>	
<p>Milton B. Adams</p>	<p>Fort D. A. Russell, Wyo. Member of Boards of Engineer Officers to establish the harbor-lines in Quincy Bay, Ill., and on bridge across the Mississippi River at La Crosse, Wis.</p> <p>In charge of the defensive works at Fort Montgomery, N. Y. In charge of the improvement of the harbors at Ogdensburg, on the river St. Lawrence, and Plattsburgh, Burlington, and Swanton; of the channel between the islands of North Hero and South Hero, and construction of breakwaters at Rouse's Point and Gordon's Landing on Lake Champlain. In charge of the improvement of Ticonderoga and Grass rivers, and of narrows at Lake Champlain, N. Y., and Otter Creek, Vt. In charge of preliminary examination for extension on north end of breakwater at Plattsburgh; Salmon River from Fort Covington to the international line; shoals between the Sister Islands and the Cross-over Light in St. Lawrence River; Lake George, with view to placing buoys and improving channel; Great Chazy River from its mouth to Champlain Village, N. Y.; and Swanton Harbor, Vt. In charge of survey of Salmon and Great Chazy rivers, and of shoals between the Sister Islands and the Cross-over Light in St. Lawrence, N. Y.</p>
<p>William R. Livermore ..</p>	<p>In temporary charge of the defensive works of forts at Clark's Point, Mass., Dutch Island and Fort Adams, R. I. In temporary charge of the improvement of the harbors of Nantucket, Wood's Holl, Wareham, Hyannis, New Bedford, and Vineyard Haven, Mass., Newport and Block Island, R. I., and Stonington, Conn. In temporary charge of the construction of harbor of refuge at Wood's Holl, Mass. In temporary charge of the improvement of the rivers Taunton, Mass., Pawtucket, Providence, Warren, and Pawcatuck, and Narragansett Bay, R. I., and Little Narragansett Bay, R. I. and Conn., and removal of Green Jacket Shoal, Providence River, R. I. In charge, temporarily, of preliminary examination of Taunton River; inner and outer harbor at Edgartown, Martha's Vineyard; Westport Harbor, and East and West Branch of Westport River, Mass.; Fishing Place Cove near Seaconnet Point, for breakwater; cove near southeast extremity of Coaster's Harbor Island, and water-way between said island and Rhode Island; entrance to Point Judith Pond west of Point Judith, for harbor of refuge; coast near life-saving station to East Point Judith, for breakwater; Greenwich Bay to deepen water on the bar at Long Point; and for a survey of Narragansett Bay at the mouth of Narrow River, for breakwater, R. I. In charge of survey of Martha's Vineyard, inner and outer harbor at Edgartown, Mass.; cove near southeast extremity of Coaster's Harbor Island, and water-way between said island and Rhode Island; coast near life-saving station, East Point Judith, with a view to constructing a breakwater; and Narragansett Bay at the mouth of Narrow River, R. I. In charge of construction of draw protection at the bridge across Taunton River, Somerset, Mass., and of aids to navigation through draw of Tiverton Bridge, Sakonnet River, R. I. In charge of removal of wreck of schooner <i>Alma</i> from Vineyard Haven Harbor, and of wreck of schooner <i>Annie E. Hays</i> from Buzzard's Bay, Mass. Member of Board of En-</p>

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
MAJORS. (continued.)	
William H. Heuer	<p>gineer Officers to consider the matter of the harbor lines of the port of Boston. Temporarily a member of Advisory Council to the Rhode Island State Board of Harbor Commissioners.</p> <p>In charge of the improvement of Humboldt Harbor and Bay, Cal. In charge of the improvement of the Sacramento, Feather, San Joaquin, and Mokelumne Rivers, and Petaluma Creek, Cal. In charge of preliminary examination of entrance and inside bars to head of navigation of Eel and Klamath rivers, Cal.; and the necessity for the establishment and maintenance of public moorings for the protection of shipping in the open and exposed ports on the northern coast of California at Fort Ross, Fish's Mill, Fish Rock, Shelter Cove, Trinidad, etc. Member of Boards of Engineer Officers to establish the harbor lines of San Francisco and San Diego harbors and adjacent waters; and to examine and investigate the mining débris question in the State of California, etc. Engineer twelfth Light-house District.</p>
William S. Stanton.....	Detached; Engineer first and second light-house districts.
Thomas H. Handbury ..	<p>In charge of the defensive works at Forts Stevens, Oregon, and Canby, Wash. In charge of the improvement of the canal at the Cascades, Oregon, mouth of the Columbia River, Oregon and Wash.; of the rivers Chehalis, Skagit, Steilaquamish, Nootsack, Snohomish, and Snoqualmie, Wash. In charge of water-gauges on the Columbia River from Astoria to the bar. In charge of examination and survey of the Columbia River, Oregon. Disbursing officer of Board of Engineer Officers on obstructions to navigation in the Columbia River at The Dalles and Celilo Falls, and at Three and Ten Mile Rapids. Member of Boards of Engineer Officers on improvement of Coos and Yaquina Bays, Oregon, and to examine and investigate the mining débris question in the State of California, etc. Engineer thirteenth Light-house District.</p>
James C. Post	<p>In charge of the Third Division, Office of the Chief of Engineers. Member of the Boards of Engineer Officers on improvement of Charleston Harbor, S. C., for improving Cumberland Sound and Savannah River, below Savannah, Ga., and on obstructions to navigation in the Columbia River at The Dalles and Celilo Falls, and at Three and Ten Mile Rapids. Absent in Europe under orders from the Secretary of War.</p>
James F. Gregory	Detached; Engineer Secretary of the Light-House Board.
Henry M. Adams	<p>On duty in Office of the Chief of Engineers. On duty under the direction of the Secretary of War. In charge of the Third Division, Office of the Chief of Engineers. Member of Board of Engineer Officers on bridge across the Detroit River at Detroit, Mich.</p>
Charles E. L. B. Davis...	<p>In charge of the improvement of the harbors at Ashland, Wis.; Ontonagon, Eagle Harbor, Marquette, Manistique, and Cedar River, Mich.; Menomonee, Oconto, Pensauckee, Green Bay, Ahnapee, Kewaunee, Two Rivers, Manitowoc, Sheboygan, and Port Washington, Milwaukee, Racine, and Kenosha, Wis., and Waukegan, Ill. In charge of harbors of refuge at Milwaukee Bay, Wis., at entrance to Sturgeon Bay Canal, Lake Michigan, and Grand Marais, Mich. In charge of the improvement of the rivers Fox and Wisconsin, Wis. In charge of preliminary examination of Centreville Creek; Racine Harbor;</p>

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
<p style="text-align: center;">MAJORS. (continued.)</p> <p>James B. Quinn.....</p> <p>Daniel W. Lockwood...</p> <p style="text-align: center;">CAPTAINS.</p> <p>Ernest H. Ruffner</p> <p>John C. Mallery.....</p> <p>Clinton B. Sears.....</p> <p>Thomas Turtle</p>	
	<p>Kenosha harbor for refuge; harbor at mouth of Fond du Lac River, Lake Winnebago; and Oconto and Menomonee harbors, Wis. In charge of survey of harbor at mouth of Fond du Lac River, in Lake Winnebago, and of Menomonee Harbor from the waters of Green Bay to N. Ludington & Co.'s mill, Wis. In charge of water-level observations on Lake Superior. In charge of water-level observations on Lake Michigan. In charge of the establishment and maintenance of harbor lines in Portage Lake, Mich. Member of Board of Engineer Officers to establish the harbor lines in Marquette Harbor, Mich.</p> <p>In charge of the improvement of the harbors of Duluth, Grand Marais, Agate Bay, Minn., Superior Bay on Lake Superior, St. Louis Bay, and Ashland, Wis., Ontonagon, Eagle Harbor, and Marquette, Mich., and the harbor of refuge at Grand Marais, Mich. In charge of preliminary examination at Duluth, Minn.; Black River, Lake Superior, to deepen channel and for breakwater, Mich. In charge of survey at Duluth, Minn., and at Minnesota Point, at Superior, at the west end of Lake Superior. In charge of water-level observations on Lake Superior. In charge of the establishment and maintenance of harbor lines in Portage Lake, Mich. To exercise supervision over construction of bridge across the St. Louis River between the States of Minnesota and Wisconsin. Member of Board of Engineer Officers to establish the harbor lines in Marquette Harbor, Mich.</p> <p>In charge of the improvement of Little Kanawha, Guyandotte, and Buckhannon rivers, W. Va., Big Sandy River, W. Va. and Ky.; of the Kentucky, Tradewater, Green, and Barren rivers; and of Licking River from Farmer to West Liberty, Ky. In charge of negotiations for the purchase of the Green and Barren river improvement, Ky. In charge of preliminary examinations of Big Sandy River from Catlettsburgh to Pikeville, on Louisa Fork, and to the mouth of Pond Creek on Tug Fork, Ky. To exercise supervision over the construction of the proposed road of the Carrollton, or Lock No. 1, Turnpike Company, through the land of the United States at Lock No. 1, Kentucky River; of bridge across the Tradewater River; and of bridge across the Kentucky River at or near Tyrone, Ky. Member of Boards of Engineer Officers on proposed bridge across the Ohio River at Louisville, Ky.; and to examine and report upon the bridge now being constructed across the Green River, below Lock No. 1.</p> <p>In charge of the improvement of the Mississippi River between Des Moines Rapids and the mouth of the Illinois River. In charge of preliminary examination of Clarksville Harbor, Mo. Member of Board of Engineer Officers to establish the harbor lines in Quincy Bay, Ill.</p> <p>Detached; Engineer fifth and sixth Light-house districts.</p> <p>In charge of the First and Second Divisions, Office of the Chief of Engineers.</p> <p>In charge of the Fourth and Fifth divisions, office of the Chief of Engineers. In temporary charge of the defensive works at Forts Carroll and McHenry, Baltimore, Md.; the improvement of the harbor at Baltimore, Md.; the improvement of James River, Va., and New River, Va.</p>

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
CAPTAINS. (continued.)	
Edward Maguire	and W. Va., and Gauley, Great Kanawha, and Elk rivers, W. Va. In charge of removal of wreck of schooner <i>Wallace M. French</i> from the Patapsco River above Fort Carroll. Member of Board of Officers on revision of blank forms, etc., now in use in the Army, and for the preparation of the "Book of Forms," for issue.
Frederick A. Mahan	Commanding Company B, Battalion of Engineers. Instructor in Military Engineering at the Engineer School of Application. Member of Board of Engineer Officers to report upon the "Auto-Mobile Controllable Torpedo," of Mr. J. N. H. Patrick. Detached; Engineer Fourth Light-house District.
Charles F. Powell	In charge of the improvement of the harbors at Erie, Pa., and Buffalo, Wilson, Olcott, Oak Orchard, and Dunkirk, N. Y. In charge of improvement of Tonawanda Harbor and Niagara River, N. Y. In charge of survey of the peninsula and harbor at Erie, Pa. In charge of the preservation and protection of the peninsula of Presque Isle, Erie Harbor, Pa. Member of Board of Engineer Officers on improvement of Buffalo and Erie harbors.
Frederick A. Hinman ...	Secretary and disbursing officer of the Mississippi River Commission created by act of Congress approved June 28, 1879. Secretary and assistant to the construction committee of the Mississippi River Commission, and disbursing officer for works carried on by the Commission.
John G. D. Knight	On sick leave of absence. Found incapacitated for active service by an Army Retiring Board and granted indefinite leave of absence on account of disability.
Richard L. Hoxie	Detached; Instructor of Engineering at the United States Infantry and Cavalry School.
William L. Marshall	In charge of the defensive works at Forts McRee, Pickens, and Bacrancas, Fla. In charge of the improvement of Pensacola Harbor, Fla. In charge of the improvement of the rivers Coosa and Chattahoochee, Ga. and Ala., Ocmulgee, Oconee, Oostenaula, Coosawattee, and Flint, Ga., Choctawhatchee, Escambia, and Conecuh, Fla. and Ala., Alabama, Cahawba, and Tallapoosa, Ala., Apalachicola River and Bay, and La Grange Bayou, Fla. In charge of resurvey of outer and inner bars at Pensacola, Fla. In charge of preliminary examination of the Coosa River for location of channel from the rapids at Wetumpka to connect with the improvements above the Ten Islands; and Choctawhatchee River, Ala.; Saint Andrew's Bay; Chipola River from its mouth to Marianna, and to Wewahitchka and the "Cut-off," and "Lee's Slough" running from the Apalachicola River to the Chipola River, Fla.; and rock-reefs at Albany and above, Flint River, Ga. In charge of removal of wreck of ship <i>Bride of Lorne</i> in Pensacola Harbor, Fla. Commanding Company B, Battalion of Engineers. Instructor in Military Engineering at the Engineer School of Application. Member of General Court-Martial convened at Willets Point, N. Y., on May 27, 1889.
	In charge of the improvement of the harbors at Milwaukee, Racine, and Kenosha, Wis., Waukegan, Chicago, and Calumet, Ill., and harbor of refuge at Milwaukee Bay, Wis. In charge of the improvement of the Fox, Wisconsin, Illinois, and Calumet rivers. In charge of preliminary examination of Grand Calumet River, Ind. and Ill.; of survey of a canal-way to connect Lake Michigan

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
CAPTAINS. (continued.)	with the Calumet River; and of Berry Lake, Ind. In charge of survey of the Hennepin Canal. In charge of the location of the Illinois and Mississippi Canal. In charge of water-level observations on Lake Michigan. Member of Board of Engineer Officers on improvement of navigation at Rock Island Rapids, Mississippi River. Engineer Officer, Division of the Missouri.
Joseph H. Willard.....	In charge of the improvement of Tensas River and Bayou Macon, La., Ouachita and Black River and Bayou Bartholomew in La. and Ark., Little River, Boeuf River, Bayous D'Arbonne, Rondeway, and Vidal, La.; Cypress Bayou, La. and Tex.; Red River, La. and Ark., Ouachita River above Camden, Ark.; North Fork and main river of the Forked Deer River, and South Forked Deer River, and the Big Hatchie River, Tenn.; of the rivers Big Sunflower, Yazoo, Yallahusha, Big Black, and Tallahatchie, and Tchula Lake, and Steele's Bayou, Miss. In charge of preliminary examination of Ouachita River, La. and Ark., from its mouth to head of navigation; Bayou Dorcheat from Lake Bisteanau to the Arkansas line, La.; and Bogue Phalia, Miss. In charge of the water-gauges on the Lower Mississippi River and its principal tributaries. To supervise the construction of the bridge across Yazoo River, near Greenwood, Miss., and across Sunflower River, near Johnsonville, Miss., and to supervise changes and alterations in the bridge across Big Black River at Allen's Station, Miss.
Philip M. Price.....	Detached; on duty at the Military Academy as instructor of Practical Military Engineering, and in command of Company E, Battalion of Engineers. In charge of water-works and supply-line, and Acting Signal Officer at West Point, N. Y. In charge of the erection of a monument at Washington's Headquarters at Newburgh, N. Y. Member of General Court-Martial convened at West Point, N. Y., on August 20, 1888. In charge of the defensive works at Forts McRee, Pickens, and Barrancas, Fla. In charge of the improvement of Pensacola Harbor, Fla. In charge of the improvement of the rivers Coosa and Chattahoochee, Ga. and Ala., Flint, Ga., Choctawhatchee, Escambia, and Conecuh, Fla. and Ala., Alabama, Cahawba, and Tallapoosa, Ala., Apalachicola River and Bay, and La Grange Bayou, Fla. In charge of survey of the Coosa River for location of channel from the rapids at Wetumpka to connect with the improvement above the Ten Islands, Ala. In charge of resurvey of outer and inner bars at Pensacola, Fla.
Carl F. Palfrey.....	In charge of the defensive works at Forts Porter, Niagara, and Ontario, N. Y. In charge of the improvement of the harbors at Charlotte, Pultneyville, Great Sodus, Little Sodus, Oswego, and Sackett's Harbor, N. Y. In charge of revision of surveys and estimates for water-way around Niagara Falls, N. Y. In charge of preliminary examination of Black River from Brownville to Lake Ontario; Cape Vincent Harbor for breakwater; harbor of refuge at Frontberg, Lake Ontario; Genesee River, south of the harbor and above the village of Charlotte; channel connecting Irondequoit Bay with Lake Ontario for harbor of refuge; harbor at Troutberg; and harbor, mouth of Salmon River, Lake Ontario, N. Y. In charge of water-level observations on Lake Ontario.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
CAPTAINS. (continued.)	
William H. Bixby	In charge of the defensive works at Forts Macon and Caswell, N. C. In charge of the improvement of Beaufort Harbor, N. C., and Georgetown Harbor, S. C. In charge of the improvement of Cape Fear River above and below Wilmington, Roanoke, Neuse, Pamlico, Tar, Yadkin, Black, Trent, and New rivers, and Contentna or Moccasin River, and inland water-way from New Bern to Beaufort, and inland water-way between Beaufort Harbor and New River, N. C.; and Santee, Wateree, Great Pee Dee, Waccamaw and Congaree rivers, and Winyaw Bay, S. C. In charge of preliminary examination of Trent River to upper Quaker Bridge; Fishing, Swift, and Mackey's creeks; North East River (Cape Fear); Shallotte and White Oak rivers; water-way between New River and Swansborough; Pasquotank River above the mouth of Turner's Cut; Cape Fear River from Wilmington to the ocean; Ocracoke Inlet; and Tar River from Tarborough to Rocky Mount, N. C.; and Roanoke River between Clarksville and Eaton Falls, Va. In charge of survey of Shallotte River, N. C. In charge of removal of wreck of schooner <i>Laura J.</i> , in Bogue Sound, N. C. To exercise supervision over the construction of bridge across the Cape Fear River at Fayetteville, N. C. Member of Board of Engineer Officers on further improvement of the harbors of St. Augustine and Key West, Fla., and to establish the harbor lines of Savannah and Brunswick harbors.
Henry S. Taber	In charge of the improvement of the Arkansas River—removal of snags, etc.; Arkansas River at Pine Bluff, and of rivers White, St. Francis, Red above Fulton, Little Red and Petit Jean, Ark., Black, Mo. and Ark.; Cache River, Ark.; Little River and St. Francis River, Mo.; and of removal of rock shoals in Fourche River, Ark. In charge of examination of Red River at railroad bridge, Fulton, Ark. To supervise the construction of bridge across the Poteau River in the Choctaw Nation, near Fort Smith, Ark.
Eric Bergland	Commanding Company C, Battalion of Engineers. Instructor in Civil and Military Engineering at the Engineer School of Application.
William T. Russell	In charge of Third District of the Mississippi River, from mouth of White River to Warrenton, for the purpose of improvement and the construction and repair of levees, to include the improvement of the harbor at Vicksburg, Miss. Member of Board of Engineer Officers on building and repair of levees on the Mississippi River. In temporary charge of First District of the Mississippi River, from Cairo to foot of Island No. 40, and of Second District, from foot of Island No. 40 to mouth of White River, for the purpose of improvement and the construction and repair of levees.
Thomas W. Symons	Detached; Assistant to the Engineer Commissioner of the District of Columbia.
Smith S. Leach	In charge of First District of the Mississippi River, from Cairo to foot of Island No. 40, and of Second District, from foot of Island No. 40 to mouth of White River, for the purpose of improvement and the construction and repair of levees. To exercise supervision over construction of bridge across the Mississippi River at Memphis, Tenn. Member of Board of Engineer Officers on building and repair of levees on the Mississippi River.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
CAPTAINS. (continued.)	
Dan C. Kingman	In charge of Fourth District of the Mississippi River, from Warrenton to Head of the Passes, for the purpose of improvement and the construction and repair of levees, to include levees and special work on the river, the improvement of the harbor at New Orleans, the Mississippi River at Natchez and Vidalia, the mouth of Red River at the mouth of Bayou Plaquemine, and the rectification of the Red and Atchafalaya rivers at mouth of Red River. Member of Board of Engineer Officers on proposed bridge across the Mississippi River at Memphis, Tenn. Member of Board of Engineer Officers on building and repair of levees on the Mississippi River.
Eugene Griffin	On temporary duty in office of the Chief of Engineers. On leave of absence.
Willard Young	In charge of the improvement of Tillamook Bay and Bar, harbor at Yaquina Bay, entrance to harbor at Coos Bay, and of Umpqua and Coquille rivers, Oregon. In charge of preliminary examination of Siuslaw River and Bar, Clackamas and Tualatin rivers, Nehalem Bay and Bar, Young's River and its tributary, Klaskanine River, and Umpqua River, Oregon. In charge of survey of Siuslaw River and Bar, Nehalem Bay and Bar, Young's River and its tributary, Klaskanine River, and Umpqua River, between Scottsborough and its mouth, Oregon. In temporary charge of the improvement of the Upper and Lower Columbia and Snake rivers, Oregon and Wash., Willamette River above Portland, and Lower Willamette River below Portland, Oregon, Cowlitz River, Wash., Yamhill River, Oregon, and Lower Clearwater River, Idaho.
William M. Black	In charge of the defensive works at Forts Marion and Taylor, Fla. In charge of the improvement of the harbors at Key West, including entrance thereto, Tampa Bay, Cedar Keys, and St. Augustine, Fla. In charge of the improvement of the St. John's River (at channel over bar at mouth, and Upper St. John's River), Volusia Bar, Caloosahatchee, Manatee, Withlacoochee, Suwanee, and Peace rivers, Fla. In charge of examination and survey of entrance to harbor at Key West, Fla. In charge of preliminary examination of St. Mark's, Homosassa, Crystal, and Alafia rivers and bars at their mouths; Oclawaha River, from its mouth to Lake Griffin; Sarasota Bay; and the channel between Tampa Bay and Old Tampa Bay, Fla. In charge of survey of Sarasota Bay, Fla. In charge of removal of wrecks of <i>Transport, Maple Leaf</i> , and German brig from St. John's River, between its mouth and Lake George.
L. Fisk	In charge of the defensive works of Forts Jefferson and Taylor, Fla., and Jackson, St. Philip, Livingston, Pike, Macomb, Tower Dupré, Battery Bienvenue, and tower at Proctorsville, La. In charge of the improvement of the Amite, Tangipahoa, Tickfaw, Tchefuncte, Bogue Falia, and Calcasieu rivers, bayous Terrebonne, Teche, Black, and Courtableau, and Calcasien Pass, La. Sabine Pass, Blue Duck Bar, and Neches River, Tex., and Sabine River, La. and Tex., Bayou Plaquemine, La., and of removal of obstructions in Bayou La Fourche, La. In charge of connecting Bayou Teche with Grand Lake at Charenton, La. In charge of preliminary examination of Bayou Teche, from mouth to St. Martinsville; Atchafalaya River, from Berwick's Bay to Gulf of Mexico;

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
CAPTAINS. (continued.)	
Solomon W. Roessler ...	<p>mouth and passes of Calcasieu River; Bayou Terrebonne, for continuing dredging three miles above Houma; harbor of Baton Rouge; Tangipahoa River; Tchefuncte and Bogue Falis; Bayou Chitta; Bayou des Glaisses, with a view to establishing locks; Bayou St. John, from head of navigation to Lake Pontchartrain; Bayou La Fourche, from Donaldsonville to Gulf; Amite River; Bayou Manchac; Bayou Teche, with a view to putting in locks; Tickfaw River, La.; and bayous Terrebonne and Black, with the view of opening a shorter water-way between Mississippi River and Berwick's Bay, Tex. and Mex. In charge of removal of wreck of ship <i>Ile Marthe</i> and Vallette Dry Dock in Mississippi River at New Orleans, La. To report upon the depth and width of a channel secured and maintained by jetties constructed by James B. Eads at the mouth of the Mississippi River. Engineer seventh and eighth Light-house districts.</p> <p>Commanding Company A, Battalion of Engineers. Instructor in submarine mining at the Engineer School of Application. Member of Board of Engineer officers to report upon the "Auto-Mobile Controllable Torpedo" of Mr. J. N. H. Patrick.</p>
George McC. Derby	<p>In charge of the improvement of Keyport Harbor. In charge of the improvement of the rivers Shrewsbury, Rahway, Elizabeth, Manasquan, South, Raritan, and Passaic above and below Newark, and Woodbridge, Cheesapeake, and Mattawan creeks, N. J. In charge of survey of the Staten Island shore and Arthur Kill near Staten Island Bridge, N. Y. and N. J. In charge of preliminary examination of East Rockaway Creek, Long Island, N. Y.; Wappinger's Creek, from Wappinger's Falls to its mouth; Tarrytown Harbor; for a ship-channel between Jersey City and Ellis Island; and of the East River, with a view to the removal of a ledge of rocks from the foot of Broome street to the foot of Twenty-third street, in New York City, N. Y. In temporary charge of the defensive works at Fort Sandy Hook, N. J., and Fort Hamilton, N. Y. In temporary charge of the improvement of the harbors of New York, Rondout, and Saugerties, N. Y. In temporary charge of the improvement of Arthur Kill between Staten Island and the New Jersey shore, N. Y. and N. J. In temporary charge of the improvement of the Hudson and Harlem rivers and Sheepshhead and Canarsie bays, N. Y.; Raritan Bay, N. J.; channel in Gowanus Bay and Buttermilk Channel; channel between Staten Island and New Jersey, and deepening Gedney's Channel, and Newtown Creek and Sumpawanus Inlet, N. Y. In temporary charge of Hackensack River from the lower bridge at the town of Hackensack to the Erie Railway Bridge, N. J. In temporary charge of the removal of obstructions in East River and Hell Gate, N. Y. To exercise, temporarily, supervision over construction of proposed bridge across the East River between the city of New York and Long Island. Member of Board of Engineer Officers on improvement of Buffalo and Erie harbors. Detached; on duty at the Military Academy as instructor of practical military engineering, and in command of Company E, Battalion of Engineers. In charge of water-works and supply line, and acting signal officer at West Point, N. Y. In charge</p>

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
CAPTAINS. (continued.)	of the erection of a monument at Washington's Headquarters at Newburgh, N. Y. In temporary command of ordnance detachment at the Military Academy. President of General Court-Martial convened at West Point on January 28, 1889.
James L. Lusk.....	Detached; assistant to the Engineer Commissioner of the District of Columbia.
Frederic V. Abbot.....	In charge of the defensive works at Forts Moultrie, Sumter, and Johnson, and Castle Pinckney, S. C. In charge of the improvement of the harbor at Charleston, S. C.; in charge of the improvement of Lumber River, N. C.; Mingo Creek or River; Clark Creek or River; of the Ashley, Edisto, Salkiehatchie, Little Pee Dee, Great Pee Dee, Santee, Wateree, and Congaree rivers and Wappoo Cut, S. C.; and Waccamaw River, N. C. and S. C. In charge of preliminary examination of Broad and Saluda River above Columbia; Beaufort River from three miles south of Beaufort through to Coosaw River; Ashepoo River from the Charleston and Savannah Railroad Bridge, 6 miles down the river; to connect North and South Edisto rivers by St. Pierre River and South Creek; Owendaw and Wando rivers, and other waters and water-routes connecting Bull's Bay and the harbor of Charleston; Socastee Creek from its entrance into Waccamaw River to the bridge at Socastee; and Combahee River, S. C. In charge of survey of Beaufort River, from a point three miles south of the town of Beaufort through to Coosaw River, with view to its improvement, especially at Brickyard, and of Owendaw and Wando rivers, and other waters and water-routes connecting Bull's Bay and the harbor of Charleston, S. C.
Thomas L. Casey.....	On duty under the immediate orders of Major Livermore. In charge of the improvement of Keyport Harbor, N. J. In charge of the improvement of Arthur Kill between Staten Island and the New Jersey shore, N. Y. and N. J. In charge of the improvement of the rivers Shrewsbury, Rahway, Elizabeth, South, Raritan, and Passaic above and below Newark, N. J.; Sheepshead and Canarsie bays, and Sumpawanns Inlet, N. Y.; and channel between Staten Island and New Jersey. In charge of survey of Hackensack River from the lower bridge at the town of Hackensack to the Erie Railway Bridge, N. J.
FIRST LIEUTENANTS.	
Theodore A. Bingham...	Detached; secretary and disbursing officer of the Missouri River Commission, created by act of Congress approved July 5, 1884.
Curtis McD. Townsend..	On duty under the immediate orders of Major Lydecker. On duty under the immediate orders of Colonel Wilson, in connection with the Washington Aqueduct and the water supply of the District of Columbia.
Gustav J. Fieberger.....	Detached; on duty at the Military Academy as Assistant Professor of Civil and Military Engineering. On duty under the immediate orders of Colonel Craighill. In charge of the improvement of the harbor at Norfolk and the approach to Norfolk Harbor and the United States Navy-Yard, Va. In charge of the improvement of the Appomattox and Nansemond rivers, including mouths of Bennett's and Chuckatuck creeks, Va.; Currituck Sound, Coanajok Bay and North River Bar, N. C. In charge of

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
FIRST LIEUTENANTS. (continued.)	
Oberlin M. Carter	<p>preliminary examination of Hampton Creek and Bar; Hospital Point and Chuckatuck and Bennett's creeks, Va. In charge of removal of wreck of bark <i>E. L. Pettigill</i>, in Chesapeake Bay, in main ship-channel to Norfolk, Va. Member of Board of Engineer Officers to establish the harbor lines of Norfolk and Portsmouth harbors and their adjacent waters.</p> <p>In charge of the defensive works at Forts Oglethorpe and Pulaski, Ga., and Clinch, Fla. In charge of the improvement of the harbors at Savannah and Brunswick, Ga. In charge of the improvement of Cumberland Sound, Ga. and Fla., Savannah, Altamaha, Ocmulgee, and Oconee Rivers, Jekyl Creek, and Romerly Marsh, Ga. In charge of resurvey of Ocmulgee River, Ga., and of preliminary examination of Savannah River above Augusta, and between Augusta and Andersonville; Oconee River, Ga.; and Savannah River, as to the damage to the Vernezobie Freshet Bank in 1867, S. C. In charge of survey of Savannah River above Augusta, and between Augusta and Andersonville; and of Oconee and Ocmulgee rivers, Ga. To exercise supervision over the construction of bridge across the Oconee River at or near Dublin, Ga. Member of Boards of Engineer Officers to establish the harbor lines of Savannah and Brunswick harbors.</p>
George W. Goethals	Detached; on duty at the Military Academy in Department of Civil and Military Engineering; and as Assistant Professor of Civil and Military Engineering.
John Millis.....	Detached; on Light-house duty under the immediate orders of Major Heap.
John Biddle.....	Detached; on duty as Assistant Instructor of Practical Military Engineering at the Military Academy, and with Company E, Battalion of Engineers. Officer in charge of Post Schools and Recruiting Officer for Company E, Battalion of Engineers. In temporary command of Company E, Battalion of Engineers. Member of General Court-Martial convened at West Point on May 24, 1889.
Harry F. Hodges	On duty under the immediate orders of Colonel Poe. Detached; on duty at the Military Academy in Department of Civil and Military Engineering.
James G. Warren	Adjutant and Treasurer of the Battalion of Engineers and Post of Willets Point, and Signal Officer and Recruiting Officer, Post of Willets Point. Commanding Company D, Battalion of Engineers. Inspector of small-arms practice, Battalion of Engineers. In charge of property pertaining to the Library of the Engineer School of Application. Member of General Court-Martial convened at Willets Point on May 27, 1889.
Edward Burr.....	On duty under the immediate orders of Major Handbary.
Lansing H. Beach	<p>On duty under the immediate orders of Lieutenant-Colonel Merrill. In temporary charge of the improvement of the Ohio River, Monongahela River, W. Va., Allegheny River, Pa., and of the Muskingum River, Ohio; of the construction of harbor of refuge at mouth of the Muskingum River, and of a dam at Herr's Island, Pa. To exercise supervision, temporarily, over the construction of bridges across Ohio River at Cairo; between Cincinnati and Newport; between Wheeling, W. Va., and Martin's Ferry, Ohio; near the mouth of Cork's Run, in Allegheny County, Pa., and over Muskingum River, at Stockport, Ohio. Member and Disbursing Officer of</p>

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
FIRST LIEUTENANTS. (continued.)	
	Commission to run and mark the boundary lines between a portion of the Indian Territory and the State of Texas.
Graham D. Fitch	On duty under the immediate orders of Captain Marshall.
Eugene J. Spencer	On duty under the immediate orders of Major Davis.
	Detached; on duty at the Military Academy in Department of Chemistry, Mineralogy, and Geology. Member of General Courts-Martial convened at West Point, on August 20, 1888, and January 28, 1889.
George A. Zinn	On duty under the immediate orders of Major Ernst. Q. M. Battalion of Engineers. A. A. Q. M., and A. C. S., Post of Willets Point. Instructor in Military Photography at the Engineer School of Application. Member of General Court-Martial convened at Willets Point on May 27, 1889.
William C. Langfitt	Detached; Engineer Officer Department of the Columbia.
Henry E. Waterman	On duty under the immediate orders of Major Ernst.
Irving Hale	On duty under the immediate orders of Lieutenant-Colonel Barlow. On sick leave of absence.
	Q. M. Battalion of Engineers. A. A. Q. M., and A. C. S., Post of Willets Point. Instructor in Military Photography at the Engineer School of Application. Member of Board of Engineer Officers to report upon the "Auto-Mobile Controllable Torpedo" of Mr. J. N. H. Patrick.
James C. Sanford	Detached; on duty at the Military Academy in Department of Civil and Military Engineering. On temporary duty with Company E, Battalion of Engineers, for target practice.
	On duty under the immediate orders of Lieutenant-Colonel Houston. Detached; Military Attaché to the United States Legations at London, Paris, Berlin, and St. Petersburg.
Hiram M. Chittenden...	Detached; Engineer Officer Department of the Platte. Detached; in charge of the improvement of the Missouri River from Sioux City, Iowa, to Fort Benton, Mont., under the orders of the Missouri River Commission.
Cassius E. Gillette	On duty under the immediate orders of Lieutenant-Colonel Merrill. Recorder of Board of Engineer Officers on proposed bridge across the Mississippi River at Memphis, Tenn.
David DuB. Gaillard ...	On duty under the immediate orders of Captain Black.
Harry Taylor	On duty under the immediate orders of Captain Bixby.
	Detached; on duty at the Military Academy in the Department of Mathematics. On duty under the immediate orders of Lieutenant-Colonel Gillespie.
William L. Sibert	On duty under the immediate orders of Major Lockwood. Recorder of Board of Engineer Officers on the proposed bridge across the Ohio River at Louisville, Ky. Member Board of Engineer Officers to examine and report upon the bridge now being constructed across the Green River below Lock No. 1.
Joseph E. Kuhn	On duty under the immediate orders of Lieutenant-Colonel Mansfield. On duty under the immediate orders of Major Ludlow.
William E. Craighill ...	On duty under the immediate orders of Colonel Poe. On temporary duty under the immediate orders of Colonel Craighill. On duty under the immediate orders of Major Allen.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
FIRST LIEUTENANTS. (continued.)	
Henry C. Newcomer	Commanding Company C, Battalion of Engineers, temporarily. On duty with Company C, Battalion of Engineers. Under instruction at the Engineer School of Application. Assistant instructor in submarine mining at the Engineer School of Application. Member of General Court-Martial convened at Willets Point on May 27, 1889.
SECOND LIEUTENANTS.	
Mason M. Patrick	On duty with Company A, Battalion of Engineers. Under instruction at the Engineer School of Application.
Charles S. Riché	On duty with Company B, Battalion of Engineers. Under instruction at the Engineer School of Application. On duty under the immediate orders of Colonel Poe.
Thomas H. Rees	On duty with Company A, Battalion of Engineers. Under instruction at the Engineer School of Application.
Charles L. Potter	On duty with Company C, Battalion of Engineers. Range Officer, Post of Willets Point, N. Y. Under instruction at the Engineer School of Application. Member of General Court-Martial convened at Willets Point on May 27, 1889.
Francis R. Shunk	On duty with Company B, Battalion of Engineers. Acting ordnance officer, post of Willets Point, N. Y. Under instruction at the Engineer School of Application. Member of General Court-Martial convened at Willets Point on May 27, 1889.
James J. Meyler	On duty with Company C, Battalion of Engineers. Under instruction at the Engineer School of Application. On duty under the immediate orders of Major Benysaard.
Eugene W. Van C. Lucas	On duty with Company A, Battalion of Engineers. Under instruction at the Engineer School of Application. Member of General Court-Martial convened at Willets Point on May 27, 1889.
Henry Jervey	On duty with Company B, Battalion of Engineers. In charge of Post Canteen, post of Willets Point, N. Y. Under instruction at the Engineer School of Application. Judge Advocate of General Court-Martial convened at Willets Point on May 27, 1889.
Charles H. McKinstry ..	On duty with Company C, Battalion of Engineers. Under instruction at the Engineer School of Application.
William V. Judson	On duty with Company A, Battalion of Engineers. Under instruction at the Engineer School of Application.
U. S. AGENTS:	
S. T. Abert	In charge of the improvement of the harbor at Breton Bay, Leonardtown, and at entrance of St. Jerome's Creek, Md. In charge of the improvement of the Patuxent River, Md.; of the rivers Rappahannock, Chickahominy, Mattaponi, Totusky, York, Pamunkey, and Staunton, Va.; Roanoke and French Broad, N. C., and Dan, Va. and N. C.; of channel in Potomac River through flats in front of landing at Mount Vernon, and of Neabsco, Nomini, and Urbana creeks, Va. In charge of the preliminary examination of Ware River, Va.; Quantico, Occoquan, Aquia, Chickahominy, and Hull creeks; and Hunting Creek, at its mouth; Machadoc River; and the channel crossing the Potomac from Alexandria to the Maryland side, Va. In charge of survey of Chickahominy River, Occoquan and Aquia creeks, Va. In charge of the removal of three wrecks from Mattaponi River, and of removal of wreck of barge <i>Amicus</i> , from the Pamunkey River, Va.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
<p>U. S. AGENTS. (continued.)</p> <p>William F. Smith..... <i>Major of Engineers,</i> <i>U. S. A., Retired.</i></p> <p>U. S. CIVIL ENGINEER.</p> <p>M. Meigs</p>	<p>In charge of the improvement of the harbors at Wilmington, Del., and at Cambridge, Md., and ice-harbor at New Castle, Del. In charge of the improvement of the Manrice River, N. J., Broadkill, Indian, Nanticoke, and St. Jones rivers, Duck, Mispillion, and Broad creeks, Del., Susquehanna River above and below Havre de Grace; of the Chester, Wicomico, Choptank, and Pocomoke rivers, Corsica Creek, of Fairlee Creek and Inlet, upper thoroughfare at Dell's Island, Md., and inland water-way from Chincoteague Bay, Va., to Delaware Bay at or near Lewes, Del. In charge of preliminary examination of Nanticoke River from Seaforth to Concord; Malon River; Prime Hook and Appoquinimink creeks, Del.; Wicomico, Northeast, Manokin, Warwick, Wetypink, Southeast, La Trappe, Tuckahoe, Sassafra, and Elk rivers, Chester River between Crumpton and Jones' Landing; and Still Pond Harbor, Md.; Onancock Harbor; Occobannock Creek; harbor of Cape Charles City and approaches by Chenton Inlet; Chincoteague Inlet for purposes of a breakwater; and Nassowaddox River, Va. In charge of survey of Onancock Harbor and Chincoteague Inlet, Va.; Wicomico, Elk, and Northeast rivers, and Chester River between Crumpton and Jones' Landing, Md.; and Appoquinimink Creek, Del. In charge of removal of wreck of puny <i>Eva Hemingway</i> from Choptank River, near entrance to Cambridge Harbor; and of wreck of schooner <i>Two Brothers</i> from Cambridge Harbor, Md.</p> <p>On duty under the immediate orders of Major Mackenzie.</p>

L A W S

AFFECTING

THE CORPS OF ENGINEERS, UNITED STATES ARMY.

FIFTIETH CONGRESS, SECOND SESSION, 1888-'89.

ACTS.

CHAP. I.—An act to authorize the building of a bridge or bridges across the Mississippi River at La Crosse, Wisconsin. December 10, 1888. Vol. 25, p. 635.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the La Crosse and Minnesota Bridge and Ferry Company, a corporation created by or under the laws of the State of Wisconsin, its successors or assigns, be, and is hereby, authorized to construct and maintain a bridge or bridges, for the passage of vehicles of all kinds, animals, and foot-passengers, across that part of the Mississippi River west of the main channel of said river at a point opposite the said city of La Crosse: *Provided*, That it shall not be lawful to construct said bridge or bridges until the Secretary of War shall certify that the same will not materially obstruct the navigation of said river: *And provided further*, That the location and plan or manner of constructing said bridge or bridges shall be subject to the approval of the Secretary of War, and until approved by him the bridge or bridges shall not be built. And there shall be submitted to the Secretary of War for his examination and approval, a design and drawing of the bridge, and a map of the location, giving, for the space of one mile above and one mile below the proposed location, the topography of the banks of the river, the shore-lines at high and low water, the direction and strength of the currents at all stages, and the soundings, accurately showing the bed of the stream, the location of any other bridge or bridges, and all other information required.

SEC. 2. That said La Crosse and Minnesota Bridge and Ferry Company shall have the right to charge and collect a reasonable rate of toll, not exceeding the amount limited by the laws of Minnesota or Wisconsin, and approved by the Secretary of War.

SEC. 3. That this act shall be null and void if actual construction of the bridge or bridges herein authorized be not commenced within one year and completed within three years from the date of the passage hereof.

SEC. 4. That any bridge or bridges built under this act and subject to its limitations shall be a lawful structure or structures, and shall be recognized and known as a post-route, upon which no higher charge shall be made for the transmission over the same of the mails, troops, and the munitions of war of the United States passing over said bridge or bridges than the rate per mile paid for the transportation over the railroad or other public highway leading to said bridge: and equal privileges in the use of said bridge shall be granted to all telegraph companies; and the United States shall have the right of way across said bridge and its approaches for postal-telegraph purposes.

SEC. 5. That the right to alter, amend, or repeal this act is hereby expressly reserved.

Approved, December 10, 1888.

December 10, 1888. Vol 25, p. 636. CHAP. 2.—An act to authorize the construction of bridges across the Kentucky River and its tributaries by the Richmond, Nicholasville, Irvine and Beattyville Railroad Company.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Richmond, Nicholasville, Irvine and Beattyville Railroad Company, a corporation organized under act of the general assembly of the Commonwealth of Kentucky, be, and it is hereby, authorized to construct and maintain a bridge or bridges, and approaches thereto, over the Kentucky River, in the State of Kentucky, and also a bridge or bridges over the tributaries or forks of said river, at such point or points as said company may deem suitable for the passage of its said road over said river, or its tributaries or forks. Said bridge or bridges shall be constructed to provide for the passage of railway trains and, at the option of the company by which it or they may be built, may be used for the passage of wagons and vehicles of all kinds, for the transit of animals, and for foot-passengers: *Provided*, That the rates of toll charged by said company shall be first approved by the Secretary of War.

Railway, wagon, and foot-bridge.

Proviso.
Toll.

Lawful structure and post-route.

Postal tele-graph.

Secretary of War to approve plans, etc.

Use by other companies.

Terms.

Commence-ment and com-pletion.

Amendment.

SEC. 2. That any bridge built under this act, and subject to its limitations, shall be a lawful structure, and shall be recognized and known as a post-route, and it shall enjoy the rights and privileges of other post-roads in the United States, and equal privileges in the use of said bridge shall be granted to all telegraph companies; and the United States shall have the right of way across said bridge, and its approaches, for postal-telegraph purposes.

SEC. 3. That any bridge authorized to be constructed under this act shall be built and located under and subject to such regulations for the security of navigation of said river as the Secretary of War shall prescribe; and to secure that object, the said company or corporation shall submit to the Secretary of War for his examination and approval, a design and drawing of the bridge, and a map of the location thereof; and until the said plan and location of the bridge are approved by the Secretary of War, the bridge shall not be built; and should any change be made in the plan of said bridge during the progress of construction, such change shall be subject to the approval of the Secretary of War, and if the Secretary of War shall at any time think any change necessary in the plans of said bridge or bridges, or that the said bridge or bridges should be entirely removed, the said alterations or removal shall be at the expense of the company.

SEC. 4. That all railroad companies desiring the use of said bridge or bridges shall have, and be entitled to, equal rights and privileges relative to the passage of railway trains over the same and over the approaches thereto, upon the payment of reasonable compensation therefor; and in case the owner or owners of said bridge or bridges and the railroad company or companies desiring to use the same shall fail to agree upon the terms with reference to the use of same, all matters of issue between them shall be decided by the Secretary of War upon a hearing of the allegation and proofs of the parties.

SEC. 5. That this act shall be null and void if actual construction of the bridge or bridges herein authorized be not commenced within two years and completed within five years from the date thereof.

SEC. 6. That the right to alter, amend, or repeal this act is hereby expressly reserved.

Approved, December 10, 1888.

December 17, 1888. Vol. 25, p. 637. CHAP. 3.—An act granting the use of certain lands in Pierce County, Washington Territory, to the city of Tacoma, for the purposes of a public park.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That there is hereby granted to the city of Tacoma, in the County of Pierce, in the Territory of Washington, a license to occupy, improve, and control, for the purposes of a public park for the use and benefit of the citizens of the United States, and for no other purposes whatever, the following described pieces or parcels of land, situate in the County of Pierce and Territory of Washington, and described as follows, namely: Lots one, two, three, four, five, and six, and the east half of the southeast quar-

Tacoma, Wash-ington Terri-tory.
Public land in Pierce County donated for public park.

Location.

ter, and the northeast quarter of the northwest quarter, and the southwest quarter of the northeast quarter of section fifteen, township twenty-one north, of range two east, and lots one, two, and three, and the south half of the southwest quarter of section fourteen, same township and range, and lots one, two, and three in section ten of the same township and range, containing six hundred and thirty-five acres, more or less: *Provided*, That the United States reserves to itself the fee of all said lands, and that this license is granted upon the express condition that the United States may take possession of and occupy said lands or any part thereof for military or other purposes whenever its proper officials see fit to order the same, and without any claim for compensation or damage on the part of said City of Tacoma.

Approved, December 17, 1888.

Provided.
United States
to retain fee.

CHAP. 21.—An act to authorize the Cairo and Tennessee Railroad Company to construct bridges across the Tennessee and Cumberland Rivers.

January 8, 1889.
Vol. 25, p. 640.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Cairo and Tennessee River Railroad Company, organized under act of the general assembly of the Commonwealth of Kentucky, be, and is hereby, authorized to construct and maintain bridges, and approaches thereto, over the Tennessee River at any point below Aurora, south boundary of Calloway County, in the State of Kentucky, and the Cumberland River at any point in Trigg County, State of Kentucky, and at any point in Monroe or Cumberland Counties, Kentucky, or in Clay County, Tennessee, on said river. Said bridges shall be constructed to provide for the passage of railway trains, and, at the option of the corporation by which they may be built, may be used for the passage of wagons and vehicles of all kinds, for the transit of animals, and for foot-passengers.

Cairo and Ten
nessee River
Railroad Com-
pany may bridge
Tennessee and
Cumberland
Rivers.

Railway,
wagon, and foot
bridges.

SEC. 2. That any bridge built under this act and subject to its limitations shall be a lawful structure, and shall be recognized and known as a post-route, and it shall enjoy the rights and privileges of other post-roads in the United States, and equal privileges in the use of said bridges shall be granted to all telegraph companies; and the United States shall have the right of way over said bridges for postal-telegraph purposes.

To be lawful
structures and
post-routes.

SEC. 3. That all railroad companies desiring the use of said bridges shall have and be entitled to equal rights and privileges relative to the passage of railway trains over the same, and over the approaches thereto, upon the payment of a reasonable compensation for such use; and in case the owner or owners of said bridges and the several railroad companies, or any of them, desiring such use, shall fail to agree upon the sum or sums to be paid, and upon rules and conditions to which each shall conform in using said bridges, all matters at issue between them shall be decided by the Secretary of War upon a hearing of the allegations and proofs of the parties.

Postal tele-
graph.
Use by other
roads.

Compensation.

SEC. 4. That any bridges authorized to be constructed under this act shall be built and located under and subject to such regulations for the security of navigation of said rivers as the Secretary of War shall prescribe; and to secure that object the said company or corporation shall submit to the Secretary of War, for his examination and approval, a design and drawings of the bridges, and a map of the location, giving, for the space of one mile above and one mile below the proposed location, the topography of the banks of the rivers, the shore-lines at high and low water, the direction and strength of the currents at all stages, and the soundings, accurately showing the bed of the stream, the location of any other bridge or bridges, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and until the said plan and location of the bridges are approved by the Secretary of War the bridges shall not be commenced or built, and should any change be made in the plan of said bridges during the progress of construction such changes shall be subject to the approval of the Secretary of War.

Secretary of
War to approve
plans, etc.

SEC. 5. That the right to alter, amend, or repeal this act is hereby expressly reserved.

Amendment.

SEC. 6. That this act shall be null and void if actual construction of the bridges herein authorized be not commenced within two years and completed within three years from the date thereof.

Commence-
ment and com-
pletion.

Approved, January 8, 1889.

January 30, 1889. CHAP. 99.—An act to amend an act entitled "An act declaring that certain water reserve lands in the State of Wisconsin are and have been subject to the provisions of the act of Congress entitled 'An act granting to railroads the right of way through the public lands of the United States,' approved March third, eighteen hundred and seventy-five," approved September tenth, eighteen hundred and eighty-eight.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That an act entitled "An act declaring that certain water reserve lands in the State of Wisconsin are and have been subject to the provisions of the act of Congress entitled 'An act granting to railroads the right of way through the public lands of the United States,' approved March third, eighteen hundred and seventy-five," approved September tenth, eighteen hundred and eighty-eight, be amended by striking out the words "November twenty-eighth, eighteen hundred and eighty-one," where they occur in said act, and inserting in lieu thereof the words "February twentieth, eighteen hundred and eighty-two."

Approved, January 30, 1889.

February 14, 1889. CHAP. 165.—An act to authorize and empower the Mount Carmel Development Company to draw water from the Wabash River, or its tributaries, in the county of Wabash and State of Illinois.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Mount Carmel Development Company, a corporation created and existing under the laws of the State of Illinois, be, and the same is hereby, authorized and empowered to construct and operate, during its corporate existence, a hydraulic canal from any point on the Wabash River above the lock and dam now in process of construction at the Grand Rapids of said Wabash River, or from any tributary of said river within the county of Wabash and State of Illinois, to any point on said river within the corporate limits of the city of Mount Carmel, Illinois; and to draw from said Wabash River or tributary thereof such supply of water as may be required for the purposes of such corporation: *Provided,* That such withdrawal be not detrimental to the interests of navigation and be subject to the direction and control of the Secretary of War.

Approved, February 14, 1889.

February 14, 1889.
Vol. 25, p. 670.

CHAP. 166.—An act for the relief of General William F. Smith.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the President be, and he is hereby, authorized to nominate and by and with the advice and consent of the Senate, to appoint William F. Smith, late major-general United States volunteers, to the position of major of engineers in the Army of the United States, and to place him on the retired list of the Army as of that grade, (the retired list being thereby increased in number to that extent); and all laws and parts of laws in conflict herewith are suspended for this purpose only: *Provided,* That from and after the passage of this act no pension shall be paid to the said William F. Smith.

Approved, February 14, 1889.

February 23, 1889.
Vol. 25, p. 689.

CHAP. 204.—An act to authorize the construction of a bridge or bridges across the Mississippi River at La Crosse, Wisconsin.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the city of La Crosse, a municipal corporation in the county of La Crosse, State of Wisconsin, its successors or assigns, may construct and maintain a bridge for the passage of vehicles of all kinds, animals, and foot-passengers across the Mississippi River from some point within the corporate limits of

the city of La Crosse to Barron's Island, opposite the said city of La Crosse, and a bridge or bridges, for a like purpose, across that part of the Mississippi River west of the main channel of said river, from said Barron's Island to some point in the county of Houston, in the State of Minnesota: *Provided*, That it shall not be lawful to construct said bridge or bridges until the Secretary of War, after an examination and report by a board of three United States engineers, and appointed by him, shall certify that the same will not materially obstruct the navigation of said river: *And provided further*, That the location and plan or manner of constructing said bridge or bridges shall be subject to the approval of the Secretary of War, and until approved by him the bridge or bridges shall not be built; and there shall be submitted to the Secretary of War, for his examination and approval, a design or drawing of the bridge or bridges, and a map of the location, giving, for the space of one mile above and one mile below the proposed location, the topography of the banks of the river, the shore-lines at high and low water, the direction and strength of the currents at all stages, and the soundings, accurately showing the bed of the stream, the location of any other bridge or bridges, and all other information required.

Proviso.
Examination,
etc.
Unobstructed
navigation.

Secretary of
War to approve
plans, etc.

SEC. 2. That the city of La Crosse, its successors or assigns, shall have the right to charge and collect a reasonable rate of toll, not exceeding the amount limited by the laws of Minnesota or Wisconsin, and approved by the Secretary of War.

Toll.

SEC. 3. That this act shall be null and void if actual construction of the bridge or bridges herein authorized be not commenced within one year and completed within three years from the date of the passage hereof.

Commence
ment and comple-
tion.

SEC. 4. That any bridge or bridges built under this act and subject to its limitations shall be a lawful structure or structures and shall be recognized and known as a post-road, upon which no higher charge shall be made for the transmission over the same of the mails, troops, and the munitions of war of the United States passing over said bridge or bridges than the rate per mile paid for the transportation over the railroads or other public highways leading to said bridge; and equal privileges in the use of said bridge shall be granted to all telegraph companies, and the United States shall have the right of way across said bridge and its approaches for postal telegraph purposes.

Lawful structure
and post-
route.

SEC. 5. That the right to alter, amend, or repeal this act is hereby expressly reserved.

Postal tele-
graph.
Amendment,
etc.

Approved, February 23, 1889.

CHAP. 207. — An act directing a survey of a road from the Aqueduct Bridge to Mount Vernon and making an appropriation therefor.

February 23,
1889. Vol. 25, p.
690.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War be, and he is hereby, authorized and directed to detail one or more engineer officers of the Army to make the necessary surveys for a national road from a point in Alexandria County, Virginia, at or near the Virginia end of the Aqueduct Bridge, and thence through the counties of Alexandria and Fairfax, in said State, to Mount Vernon, who shall report the same, together with the estimated cost of building such road, to the Secretary of War, who shall transmit the same to Congress.

Mount Vernon,
Va.

Survey of road
from Aqueduct
Bridge to, au-
thorized.

SEC. 2. That the sum of ten thousand dollars, or so much thereof as may be necessary, to be expended under the direction of the Secretary of War be, and the same is hereby, appropriated, out of any money in the Treasury not otherwise appropriated, to defray the expenses of the United States in carrying out the provisions of this act. *Provided*, That nothing herein shall be construed to bind the Government of the United States to pay for any portion of the right of way for the avenue contemplated by this act.

Appropriation.

Proviso.
No liability to
buy right of way.

Approved, February 23, 1889.

ENG 89—27

February 25, CHAP. 235.—An act to authorize the construction of a bridge across the Missouri River between the city of Leavenworth, in the State of Kansas, and Platte County, in the State of Missouri.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Leavenworth and Platte County Bridge Company, a corporation duly organized and existing under the laws of the State of Kansas, its successors and assigns, be, and are hereby, authorized to construct and maintain a bridge and approaches thereto across the Missouri River between the city of Leavenworth in the State of Kansas, and Platte County, in the State of Missouri, at some point at least one-fourth of a mile from any other bridge, to be selected consistent with the interests of river navigation. Said bridge shall be constructed to provide for the passage of railway trains, wagons, and vehicles of all kinds, steam and street cars, animals, foot-passengers, and for all road travel, for such reasonable rates of toll and under such reasonable rules and regulations as may be prescribed by said corporation, its successors and assigns, and be approved from time to time by the Secretary of War.

SEC. 2. That any bridge built under this act and subject to its limitations shall be a lawful structure, and shall be recognized and known as a post-route, upon which also no higher charge shall be made for the transmission over the same of the mails, the troops, and the munitions of war of the United States than the rate per mile paid for the transportation over the railroad or public highways leading to the said bridge, and it shall enjoy the rights and privileges of other post-roads in the United States; and equal privileges in the use of said bridge shall be granted to all telegraph companies, and the United States shall have the right of way across said bridge and its approaches for postal-telegraph purposes.

SEC. 3. That said bridge shall be constructed as a ponton draw-span bridge, and shall contain a ponton draw-span of not less than four hundred feet in length, which draw-span shall be maintained over the main channel of the river at an accessible and navigable point, and the piers of said bridge shall be parallel with, and the bridge itself at right angles to, the current of the river: *Provided, also,* That said draw shall be opened promptly by said company upon reasonable signal for the passage of boats and rafts, and said company or corporation shall maintain, at its own expense, from sunset to sunrise, such lights or other signals on said bridge as the Light-House Board shall prescribe. No bridge shall be erected or maintained under the authority of this act which shall at any time substantially or materially obstruct the free navigation of said river, and if any bridge erected under such authority shall, in the opinion of the Secretary of War, obstruct such navigation, he is hereby authorized to cause such change or alteration of said bridge to be made as will effectually obviate such obstruction, and all such alterations shall be made and all such obstructions be removed at the expense of the owner or owners of said bridge, and in case of any litigation arising from any obstruction or alleged obstruction to the free navigation of said river, caused or alleged to be caused by said bridge, the case may be brought in the district court of the United States of the State of Kansas in which any portion of said obstruction or bridge may be located: *Provided further,* That nothing in this act shall be so construed as to repeal or modify any of the provisions of the law now existing in reference to the protection of the navigation of rivers, or to exempt this bridge from the operation of the same: *Provided,* That said company may construct a wagon and foot bridge alone, and in case of the construction of a wagon and foot bridge alone the draws shall be of the same length herein provided, and shall be of such construction as shall be approved by the Secretary of War, and shall be subject to all the provisions herein contained in respect to being promptly opened to admit of the unobstructed navigation of said river, and of keeping the same lighted as herein provided in case of railroad and wagon bridge, and in such case the provisions herein in relation to use for railroad purposes shall not apply.

SEC. 4. That all railroad companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of railroad trains or cars over the same and over the approaches thereto, upon payment of a reasonable compensation for

such use; and in case the owner or owners of said bridge and the several railroad companies, or any one of them, desiring such use shall fail to agree upon the sum or sums to be paid, and upon rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of war upon a hearing of the allegations and proofs of the parties.

Secretary of War to decide.

SEC. 5. That any bridge authorized to be constructed under this act shall be built and located under and subject to such regulations for the security of navigation of said river as the Secretary of War shall prescribe; and to secure that object the said company or corporation shall submit to the Secretary of War, for his examination and approval, a design and drawings of the bridge, and a map of the location, giving, for the same space of one-half mile above and one-half mile below the proposed location, the topography of the banks of the river, the shore-lines at high and low water, the direction and strength of the currents at all stages, and the soundings, accurately showing the bed of the stream, the location of any other bridge or bridges, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and until the said plan and location of the bridge are approved by the Secretary of War the bridge shall not be commenced or built, and should any change be made in the plan of said bridge during the progress of construction such change shall be subject to the approval of the Secretary of War.

Secretary of War to approve plans, etc.

SEC. 6. That the right to alter, amend, or repeal this act is hereby expressly reserved, and the right to require any changes in said structure or its entire removal, at the expense of the owners thereof whenever the Secretary of War shall decide that the public interest requires it, is also expressly reserved.

Amendment.

SEC. 7. That this act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date thereof.

Commencement and completion.

Approved, February 25, 1889.

CHAP. 240.—An act to amend an act approved March third, eighteen hundred and eighty-five, to authorize the construction of bridges across the Cumberland and Caney Fork Rivers, in Tennessee. February 25, 1889. Vol. 25, p. 695.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section one of an act approved March third, eighteen hundred and eighty-five, entitled "An act to give the assent of Congress to the construction of a railroad bridge by the East and Middle Tennessee Railroad Company over the Cumberland and Caney Fork Rivers," be amended so as to read:

Bridges across Cumberland and Caney Fork Rivers.

"That the Middle and East Tennessee Central Railroad Company and the Nashville and Knoxville Railroad Company, or either of said companies, or any company with which either may consolidate, be, and are hereby, authorized to construct and maintain a bridge and approaches thereto over the Cumberland River at the most accessible point in or near the limits of Carthage, county of Smith, and State of Tennessee. Said bridge shall be constructed to provide for the passage of railroad trains across said river, and, in the discretion of said company or companies, wagons, horses, and foot passengers. And Congress shall have the right to regulate the tolls and charges in respect of the use of said bridge."

Former act amended. Vol. 23, p. 445.

SEC. 2. That section six be amended so as to read:

"Said company or companies, or either of them, is hereby also authorized to construct a railroad bridge over the Caney Fork River at such point as may be necessary in the building of their road, subject to the provisions and limitations contained in the preceding sections of this and the act it is intended to amend."

Middle and East Tennessee Central Railroad Company and Nashville and Knoxville Railroad Company may bridge Cumberland River at Carthage, Tenn.

Bridge over Caney Fork River. Vol. 23, p. 446.

SEC. 3. That said act is hereby so amended as to empower the Secretary of War to use his discretion, in the approval of the plans of the bridges therein provided for, as to the height they shall be placed above high water, and the length of span that shall be given the main channel span whether the bridges be of continuous spans or with a draw span: *Provided*, the bridges or either of them shall not be so constructed as to limit or obstruct the navigation of said river or rivers:

Plans subject to discretion of Secretary of War.

Previous.

Unobstructed navigation.	<i>Provided also,</i> That all railroad companies desiring to use the bridges aforesaid, for the passage of their trains or cars over the same, shall have that privilege upon such just and reasonable terms as may be agreed upon by the parties, and in the event of their failure to agree, the matter shall be finally determined by the Secretary of War whose determination shall be final. Equal rights and privileges shall also be granted all telegraph and telephone companies in the placing wires upon said bridges. And if the construction of said bridges shall not be commenced in two years and completed within two years from the approval of this act, all the provisions of the same shall be void.
Use by other companies.	
Terms.	
Commencement and completion.	
Amendment.	SEC. 4. The right to amend or repeal this act whenever Congress shall deem that the public good requires it, is hereby reserved.

Approved, February 25, 1889.

February 26, 1889. Vol. 23, pp. 703, 723, 730. CHAP. 279.—An act making appropriations for the legislative, executive, and judicial expenses of the Government for the fiscal year ending June thirtieth, eighteen hundred and ninety, and for other purposes.

Legislative, executive, and judicial expenses, appropriations. *Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That the following sums be, and the same are hereby, appropriated, out of any money in the Treasury not otherwise appropriated, in full compensation for the service of the fiscal year ending June thirtieth, eighteen hundred and ninety, for the objects hereinafter expressed, namely:

WAR DEPARTMENT.

Office of Chief of Engineers. **IN THE OFFICE OF THE CHIEF OF ENGINEERS:** One chief clerk, at two thousand dollars; four clerks of class four; two clerks of class three; three clerks of class two; three clerks of class one; one clerk, at one thousand dollars; one assistant messenger; and two laborers; in all, twenty-three thousand two hundred and forty dollars.

Draughtsmen, etc. And the services of skilled draughtsman, civil engineers, and such other services as the Secretary of War may deem necessary may be employed in the office of the Chief of Engineers to carry into effect the various appropriations for rivers and harbors, fortifications, and surveys for military defenses, to be paid from such appropriations: *Provided,* That the expenditures on this account for the fiscal year ending June thirtieth, eighteen hundred and ninety, shall not exceed sixty thousand dollars; and that the Secretary of War, shall each year, in the annual estimates, report to Congress the number of persons so employed and the amount paid to each.

Proviso. Limit.

PUBLIC BUILDINGS AND GROUNDS.

Public buildings and grounds. For clerk in the office of Public Buildings and Grounds, one thousand six hundred dollars; and for messenger in the same office, eight hundred and forty dollars.

Clerk, messenger. For the public gardener, one thousand eight hundred dollars.

Gardener. For overseers, draughtsman, foremen, mechanics, gardeners, and laborers employed in the public grounds, thirty thousand dollars.

Overseers, etc. For watchman in Franklin Square, six hundred and sixty dollars.

Watchmen. For watchman in Lafayette Square, six hundred and sixty dollars.

For two day watchmen in Smithsonian Grounds, at six hundred and sixty dollars each, one thousand three hundred and twenty dollars.

For two night watchmen in Smithsonian Grounds, at seven hundred and twenty dollars each, one thousand four hundred and forty dollars.

For one watchman for Judiciary Square, and one for Lincoln Square and adjacent reservations, at six hundred and sixty dollars each, one thousand three hundred and twenty dollars.

For one watchman for Iowa Circle; one watchman for Thomas Circle and neighboring reservations; one for Rawlins Square and Washington Circle; one for Dupont Circle and neighboring reservations; one for

McPherson and Farragut Squares; one for Stanton Square and neighboring reservations; two for Henry Square, Seaton Square, and reservations east to Botanic Garden; one for Mount Vernon Square and adjacent reservations; one for greenhouses at the nursery; one for grounds south of Executive Mansion; eleven in all, at six hundred and sixty dollars each, seven thousand two hundred and sixty dollars.

For one night watchman for Henry Square, Seaton Square, and reservations east to Botanic Garden, at seven hundred and twenty dollars.

For contingent and incidental expenses, five hundred dollars.

Contingent expenses.

Approved, February 26, 1889.

CHAP. 312.—An act authorizing the construction of a bridge over the Missouri River at or near Kansas City, Kansas, and not over ten miles above the Hannibal and Saint Joseph Railway bridge at Kansas City, Missouri. March 1, 1889. Vol. 25, p. 751.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That it shall be lawful for The Kansas City Terminal Railway Company, a corporation duly and legally incorporated under and by virtue of the laws of the State of Kansas, its assigns or successors, to construct and maintain a bridge, and approaches thereto, over the Missouri River at or near Kansas City, Kansas, and not over ten miles above the Hannibal and Saint Joseph Railway bridge at Kansas City, Missouri, to be between a point in the county of Wyandotte, Kansas, and a point in the county of Platte, Missouri. Said bridge shall be constructed to provide for the passage of railway trains, and at the option of the persons by whom it may be built, may be used for the passage of wagons and vehicles of all kinds, for the transit of animals and for foot-passengers, for such reasonable rates of toll as may be approved from time to time by the Secretary of War.

Kansas City Terminal Railway Company may bridge Missouri River at Kansas City Kans. and Mo.

Railway, wagon, and foot bridge.

Toll.

SEC. 2. That any bridge built under this act, and subject to its limitations, shall be a lawful structure, and shall be recognized and known as a post-route, upon which also no higher charge shall be made for the transmission over the same of the mails, the troops, and the munitions of war of the United States, or passengers or freight passing over said bridge, than the rate per mile paid for the transportation over the railroad or public highways leading to the said bridge; and it shall enjoy the rights and privileges of other post-roads in the United States.

Lawful structure and post-route.

SEC. 3. That the said bridge shall be made with unbroken and continuous spans, the spans thereof shall not be less than four hundred feet in length in the clear, and the main span shall be over the main channel of the river. The lowest part of the superstructure of said bridge shall be at least fifty-two feet above extreme high-water mark, as understood at the point of location, and the bridge shall be at right angles to, and its piers parallel with, the current of the river: *Provided*, That nothing in this act shall be so construed as to repeal or modify any of the provisions of law now existing in reference to the protection of the navigation of rivers, or to exempt this bridge from the operation of the same.

Spans.

Provided.
Existing laws.

SEC. 4. That all railroad companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of railway trains over the same, and over the approaches thereto, upon payment of a reasonable compensation for such use; and in case the owner or owners of said bridge and the several railroad companies, or any one of them desiring such use, shall fail to agree upon the sum or sums to be paid, and upon rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War, upon a hearing of the allegations and proofs of the parties.

Use by other companies.

Compensation.

SEC. 5. That any bridge authorized to be constructed under this act shall be built and located under and subject to such regulations for the security of navigation of said river as the Secretary of War shall prescribe; and to secure that object the said company or corporation

Secretary of War to decide.

Secretary of War to approve plans, etc.

shall submit to the Secretary of War, for his examination and approval, a design and drawings of the bridge, and a map of the location, giving, for the space of one mile above and one mile below the proposed location, the topography of the banks of the river, the shore-lines at high and low water, the direction and strength of the currents at all stages, and the soundings, accurately showing the bed of the stream, the location of any other bridge or bridges, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and until the said plan and location of the bridge are approved by the Secretary of War the bridge shall not be commenced or built; and should any change be made in the plan of said bridge during the progress of construction, such change shall be subject to the approval of the Secretary of War.

Commence-
ment and com-
pletion.

SEC. 6. That this act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date thereof.

Amendment.

SEC. 7. That the right to alter, amend, or repeal this act is hereby expressly reserved.

Approved, March 1, 1889.

March 1, 1889.
Vol. 25, p. 752.

CHAP. 313.—An act to authorize the construction of a bridge across Bayou Bartholomew, at or near Ward's Ferry, Louisiana.

New Orleans,
Natchez and Fort
Scott Railway
Company may
bridge Bayou
Bartholomew, at
Ward's Ferry,
La.

Railway,
wagon, and foot
bridge.

Lawful struc-
ture and post-
route.

Postal tele-
graph.

Unobstructed
navigation.

Proviso.

Draw.

Lights, etc.

Use by other
companies.

Compensation.

Secretary of
War to decide.
Secretary of
War to approve
plans, etc.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the New Orleans, Natchez and Fort Scott Railway Company, a corporation created and existing under the laws of the State of Louisiana, be, and is hereby, authorized to construct and maintain a bridge, and approaches thereto, over Bayou Bartholomew, at or near Ward's Ferry, in Morehouse Parish, in the State of Louisiana, to Hamburg, in the State of Arkansas. Said bridge shall be constructed to provide for the passage of railway trains, and, at the option of the corporation by which it is built, may be used for the passage of wagons and vehicles of all kinds for the transit of animals, and for foot-passengers, for reasonable rates or tolls, to be fixed by said company, and approved by the Secretary of War.

SEC. 2. That any bridge built under this act and subject to its limitations shall be a lawful structure, and shall be recognized and known as a post-route, and shall enjoy the rights and privileges of other post-roads in the United States. That no higher charge shall be made for the transmission over the same of the mails, troops, and munitions of war of the United States, or for through railway passengers or freight passing over said bridge, than the rate per mile for their transmission over the railroad leading to said bridge, and equal privileges in the use of said bridge shall be granted to all telegraph companies, and the United States shall have the right of way across said bridge for postal-telegraph purposes; that the said bridge shall be constructed either by draw, span, or otherwise, so that a free and unobstructed passage-way may be secured to all water-craft navigating said river at the point aforesaid: *Provided,* That if said bridge authorized to be constructed under this act shall be constructed as a draw-bridge, the draw shall be opened promptly upon reasonable signals for the passage of boats or vessels; and said corporation shall maintain, at its own expense, from sunset to sunrise, such lights or other signals on said bridge as the Light-House Board shall prescribe.

SEC. 3. That all railroad companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of railway trains over the same, and over the approaches thereto, upon the payment of a reasonable compensation for such use; and in case the owner or owners of said bridge, and the several railroad companies, or any one of them desiring such use, shall fail to agree upon the sum or sums to be paid, and upon rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War upon the hearing of the allegations and proofs of parties.

SEC. 4. That any bridge authorized to be constructed under this act shall be built and located under and subject to such regulations for the security of navigation of said river as the Secretary of War

shall prescribe; and to secure that object the said company or corporation shall submit to the Secretary of War, for his examination and approval, a design and drawings of the bridge, and a map of the location, giving, for the space of one mile below and one mile above the proposed location, the topography of the banks of the river, the shore-lines at high and low water, the direction and strength of the current at all stages, and the soundings, accurately showing the bed of the stream, the location of any other bridge or bridges, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and until the said plan and location of the bridge are approved by the Secretary of War the bridge shall not be commenced or built; and should any change be made in the plan of said bridge during the progress of construction, so as to prevent or remove all substantial obstruction to the navigation of said river such change shall be subject to the approval of the Secretary of War; and if any litigation shall be had in regard to said bridge the same shall be in the circuit court of the United States in whose territorial jurisdiction said bridge or any part thereof is located.

Changes.

Litigation.

Amendment.

SEC. 5. That the right to alter, amend, or repeal this act is hereby expressly reserved, and any alterations or changes that may be required by the Secretary of War in the bridge constructed under this act, or its entire removal, shall be made by the corporation owning or controlling the same at its own expense. Furthermore, if the construction of said bridge shall not be commenced within two and completed within four years after the passage of this act, all privileges conferred hereby, and this act, shall become null and void.

Commencement and completion.

Approved, March 1, 1869.

CHAP. 314.—An act to authorize the construction of a bridge across the Tensas River, at or near Daniel's Ferry, Louisiana.

March 1, 1869.
Vol. 25, p. 754.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the New Orleans, Natchez and Fort Scott Railway Company, a corporation created and existing under the laws of the State of Louisiana, be, and is hereby, authorized to construct and maintain a bridge, and approaches thereto, over the Tensas River, at or near Daniel's Ferry, on a direct line from Vidalia, in Concordia Parish, to Winnaborough, in Franklin Parish, in the State of Louisiana. Said bridge shall be constructed to provide for the passage of railway trains, and, at the option of the corporation by which it is built, may be used for the passage of wagons and vehicles of all kinds, for the transit of animals, and for foot-passengers, for reasonable rates of tolls, to be fixed by said company and approved by the Secretary of War.

New Orleans, Natchez and Fort Scott Railway Company may bridge Tensas River, La.

Railway, wagon, and foot bridge.
Tolls.

SEC. 2. That any bridge built under this act and subject to its limitations shall be a lawful structure, and shall be recognized and known as a post-route, and shall enjoy the rights and privileges of other post-roads in the United States. That no higher charge shall be made for the transmission over the same of the mail, troops, and munitions of war of the United States, or for through railway passengers or freight passing over said bridge, than the rate per mile for their transmission over the railroad leading to said bridge; and equal privileges in the use of said bridge shall be granted to all telegraph companies, and the United States shall have the right of way across said bridge for postal-telegraph purposes; that the said bridge shall be constructed either by draw, span, or otherwise, so that a free and unobstructed passage-way may be secured to all water-craft navigating said river at the point aforesaid: *Provided*, That if said bridge authorized to be constructed under this act shall be constructed as a draw-bridge, the draw shall be opened promptly upon reasonable signals for the passage of boats or vessels; and said corporation shall maintain, at its own expense, from sunset to sunrise, such lights or other signals on said bridge as the Light-House Board shall prescribe.

Lawful structure and post-route.

Postal telegraph.
Unobstructed navigation.
Proviso.

Draw.

Lights, etc.

Use by other companies.

SEC. 3. That all railroad companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of railway trains over the same, and over the approaches thereto, upon the payment of a reasonable compensation for such use; and in case the owner or owners of said bridge, and the several rail-

Compensation.

road companies, or any one of them, desiring such use, shall fail to agree upon the sum or sums to be paid, and upon rules and conditions to which each shall conform in using said bridge, all matters to issue between them shall be decided by the Secretary of War upon the hearing of the allegations and proofs of the parties

Secretary of War to decide.

Secretary of War to approve plans, etc.

Changes.

Litigation.

Amendment, etc.

Commencement and completion.

SEC. 4. That any bridge authorized to be constructed under this act shall be built and located under and subject to such regulations for the security of navigation of said river as the Secretary of War shall prescribe; and to secure that object the said company or corporation shall submit to the Secretary of War, for his examination and approval, a design and drawings of the bridge, and a map of the location, giving, for the space of one mile below and one mile above the proposed location, the topography of the banks of the river, the shore-lines at high and low water, the direction and strength of the current at all stages, and the soundings, accurately showing the bed of the stream, the location of any other bridge or bridges, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and until the said plan and location of the bridge are approved by the Secretary of War the construction of said bridge shall not be commenced; and should any change be made in the plan of said bridge during the progress of construction, so as to prevent or remove all substantial obstruction to the navigation of said river such change shall be subject to the approval of the Secretary of War; and if any litigation shall be had in regard to said bridge, the same shall be in the circuit court of the United States in whose territorial jurisdiction said bridge, or any part thereof, is located.

SEC. 5. That the right to alter, amend, or repeal this act, is hereby expressly reserved; and any alterations or changes that may be required by the Secretary of War in the bridge constructed under this act, or its entire removal, shall be made by the corporation owning or controlling the same, at its own expense. Furthermore, if the construction of said bridge shall not be commenced within two and completed within four years after the passage of this act, all privileges conferred hereby, and this act, shall become null and void.

Approved, March 1, 1839.

March 1, 1889.
Vol. 25, p. 755.

CHAP. 315.—An act granting to the Astoria and South Coast Railway Company the right to construct a bridge across Young's Bay, a navigable stream in the county of Clatsop and State of Oregon.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Astoria and South Coast Railway Company, a corporation organized under the law of Oregon, with its principal office at Astoria, in the county of Clatsop, in the State of Oregon, is hereby authorized and empowered to construct a bridge across Young's Bay, a navigable stream in said county and State, at such point as the said Company may select, and may be approved by the Secretary of War, with such channel-spans, draws, safe-guards, and auxiliary works as shall cause the bridge not to obstruct or hinder the navigation of the waters crossed by it; and that said channel-spans and structures shall be according to such plans and of such materials and dimensions as the Secretary of War may prescribe; and also to construct, establish and maintain a bridge across Skipanon Creek, in the county of Clatsop, in the State of Oregon, according to such plan and of such dimensions and materials, and with such embankments and safe-guards as the Secretary of War may require; and the construction of said bridges shall not be commenced until the Secretary of War approves the plans and dimensions of the same: *Provided*, That if said bridges shall be constructed as draw bridges the draws shall be opened promptly upon reasonable signals for the passage of ships and boats, and in no case shall unnecessary delay occur; and said company shall maintain, at its own expense, from sunset to sunrise, such lights or other signals on said bridges as the Light-House Board shall prescribe.

Unobstructed navigation.

May bridge Skipanon Creek, Oregon.

Secretary of War to approve plans, etc.

Provided.

Draw.

Lights, etc.

Lawful structure and post route.

SEC. 2. That any bridge authorized to be constructed under this act shall be a lawful structure, and shall be recognized as a post-route; and it shall enjoy the rights and privileges of other post routes in the United States, upon which also no higher charge shall be made for

transmission over the same of the mails, the troops, and the munitions of war of the United States, or for through passengers or freight passing over said bridge than the rate per mile for their transportation over any railroad or other routes leading to said bridge, or over said stream in the vicinity; and the United States shall have the right of way for a telegraph across said bridges; the said bridge to be built and located under and subject to such regulations for the security of navigation on said bay and creek as the Secretary of War shall prescribe; and to secure that object the said company shall submit to the Secretary of War, for his examination and approval, a design and drawing of such bridge across Young's Bay, and an accurate map of Young's Bay from the mouths of its navigable tributaries to the adjacent ship channel, and whose topography of the shores and hydrography shall accurately represent the banks, the bottom, and steam-boat channels by contours of six feet, and which shall be accompanied by other maps, drawn to a scale of one inch to two hundred feet, giving, within areas of one-fourth of a mile from each draw-span, an accurate representation of the bottom of the bay by contour lines two feet apart, determined by accurate soundings, and also showing the force and direction of the currents at each two feet of tidal stage, by triangulated observations on suitable floats; also showing the Skipanon Creek to the head of usual navigation. The maps shall also show the locations of other bridges in the vicinity, and shall give such other information as the Secretary of War may require for a full and satisfactory understanding of the subject.

Aids to navigation.

Maps, etc.

SEC. 3. That if other railroad corporations shall desire to use the bridges herein authorized to be constructed for the passage over the same of their locomotives, cars or trains, they shall have such privilege upon terms to be agreed upon between such corporations and the owners or lessees of said bridges, and if the parties cannot agree upon such terms then the matter shall be determined by the Secretary of War, whose decision upon the subject shall be final.

Use by other companies.

Terms.

SEC. 4. That Congress shall have power, at any time, to alter or amend this act so as to prevent or remove all material and substantial obstructions to the navigation of said bay and said creek by the construction of said bridges and accessory works; and the expense of altering said bridges or removing said obstructions shall be borne by the owners of said bridges.

Amendment, etc.

SEC. 5. If the construction of the bridges hereby authorized shall not be commenced within two years and finished within four years from the time this act takes effect then all the privileges and powers herein granted shall cease and this act shall be null and void.

Commencement and completion.

Approved, March 1, 1889.

CHAP. 316.—An act to amend an act entitled "An act granting to the city of Grand Forks, Dakota, the right to build two free bridges across Red River," approved May twenty-first, eighteen hundred and eighty-eight.

March 1, 1889.
Vol. 25, p. 766.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section three of an act entitled "An act granting to the city of Grand Forks, Dakota, the right to build two free bridges across the Red River," approved May twenty-first, eighteen hundred and eighty-eight, be, and it is hereby, amended by inserting after the words "under this act," in line one, the words "below the mouth of the Red Lake River;" and further, after the words "said bridge," in line eleven, insert as follows: "And any bridge built under this act, above the mouth of the Red Lake River, shall be built with one draw-span of not less than eighty-seven feet in the clear, measured at low water, and this draw-span shall be over the main channel at the most accessible and best navigable point, and the other span may be less than eighty feet and be kept clear of trestle-work;" and the spans shall not be of less elevation than three feet above extreme high water mark as known at the point of location, measured to the lowest part of the superstructure of said bridge; also, by inserting in line thirteen, after the words "parallel to," as follows: "And except above the mouth of the Red Lake River;" and also by inserting in line fifteen, after the word "stream," as follows: "And above

Bridges across Red River of the North at Grand Forks, Dak.

Laws 1st sess. 50th Cong., p. 53.

Construction of bridges amended

the mouth of the Red Lake River the bridge may be placed at an angle of eighty-three degrees with the direction of the current of the stream."

Approved, March 1, 1889.

March 1, 1889.
Vol. 25, p. 760.

CHAP. 318.—An act to authorize the Kentucky Union Railway Company to construct a bridge across the Kentucky River and its tributaries.

Kentucky Union
Railway Company
may bridge
Kentucky River
and tributaries.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Kentucky Union Railway Company, a corporation organized under act of the general assembly of the Commonwealth of Kentucky, be, and it is hereby, authorized to construct and maintain a bridge and approaches thereto over the Kentucky River, in the State of Kentucky, and also a bridge or bridges over the navigable tributaries or forks of said river at such point or points as said company may deem suitable for the passage of its said road over said river or its said tributaries or forks. Said bridge or bridges shall be constructed to provide for the passage of railway trains, and, at the option of the company by which it or they may be built, may be used for the passage of wagons and vehicles of all kinds, for the transit of animals, and for foot-passengers; but the rate of tolls charged by said company for the passage of wagons and vehicles shall first be approved by the Secretary of War, and no tolls shall be collected unless the amount thereof is so approved.

Railway, wagon,
and foot bridge.

Lawful structure
and post-
route.

SEC. 2. That any bridge built under this act and subject to its limitations shall be a lawful structure, and shall be recognized and known as a post-route, and it shall enjoy the rights and privileges of other post-roads in the United States, and equal privileges in the use of said bridge shall be granted to all telegraph companies; and the United States shall have the right of way across said bridge and its approaches for postal-telegraph purposes.

Postal telegraph.

Secretary of
War to approve
plans, etc.

SEC. 3. That any bridge authorized to be constructed under this act shall be built and located under and subject to such regulations for the security of navigation of said river as the Secretary of War shall prescribe, and to secure that object the said company or corporation shall submit to the Secretary of War, for his examination and approval, a design and drawing of the bridge and a map of the location thereof; and until the said plan and location of the bridge are approved by the Secretary of War, the bridge shall not be commenced or built; and should any change be made in the plan of said bridge during the progress of construction, such change shall be subject to the approval of the Secretary of War; and all the expense of said change shall be paid by the parties owning or controlling such bridge or bridges.

Changes.

Use by other
companies.

SEC. 4. That all railroad companies desiring the use of said bridge or bridges shall have and be entitled to equal rights and privileges relating to the passage of railway trains over the same and over the approaches thereto upon the payment of reasonable compensation therefor; and in case the owner or owners of said bridge or bridges and the railroad company or companies desiring to use the same shall fail to agree upon the terms with reference to the use of same, all matters of issue between them shall be decided by the Secretary of War upon a hearing of the allegations and proofs of the parties.

Secretary of
War to decide.
Commencement
and completion.

SEC. 5. That this act shall be null and void if actual construction of the bridge or bridges herein authorized be not commenced within two years and completed within five years from the date thereof.

Amendment.

SEC. 6. That the right to alter, amend, or repeal this act is hereby expressly reserved.

Approved, March 1, 1889.

March 1, 1889.
Vol. 25, p. 769.

CHAP. 322.—An act to authorize the construction of a bridge across the Coosa River at Gadsden, in the State of Alabama.

Anniston and
Cincinnati Rail-
road Company
may bridge Co-
osa River at Gads-
den, Ala.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Anniston and Cincinnati Railroad Company, a corporation created and existing under the laws of the State of Alabama, having constructed a bridge, and approaches thereto, over the Coosa River, at or near Gadsden, in Ala-

wah County, on a direct line from Anniston, in Calhoun County, to Attala, in Etowah County, in the State of Alabama, said company is hereby authorized to keep and maintain the same: *Provided*, That the Secretary of War shall approve the plans and dimensions of said bridge. Said bridge if approved by the Secretary of War shall be maintained so as to be provided for the passage of railway trains, and, at the option of the corporation by which it is built, may be used for the passage of wagons and vehicles of all kinds, for the transit of animals, and for foot passengers, upon conditions to be agreed upon between said corporation and the county commissioner's court of the said county of Etowah and approved by the Secretary of War.

Proviso.

Railway,
wagon, and foot
bridge.

SEC. 2. That the bridge authorized under this act and subject to its limitations shall be a lawful structure, and shall be recognized and known as a post-route, and shall enjoy the rights and privileges of other post-roads in the United States. That no higher charge shall be made for the transmission over the same of the mail, troops, and munitions of war of the United States, or for through railway passengers or freight passing over said bridge, than the rate per mile for their transmission over the railroad leading to said bridge, and equal privileges in the use of said bridge shall be granted to all telegraph companies, and the United States shall have the right of way across said bridge for postal-telegraph purposes; that the said bridge shall, either by draw, span, or otherwise, provide and secure a free and unobstructed passage-way to all watercraft navigating said river at the point aforesaid: *Provided*, That said bridge authorized by this act being constructed as a drawbridge the draw shall be opened promptly upon reasonable signals for the passage of boats or vessels, and said corporation shall maintain at its own expense, from sunset to sunrise, such lights or other signals on said bridge as the Light House Board shall prescribe: *And provided further*, That nothing herein contained shall be held to alter or affect existing laws as to the removal of bridges obstructing the navigation of rivers when the Secretary of War shall so determine.

Lawful structure and post-route.

Postal telegraph.
Unobstructed navigation.
Proviso.
Draw.

Lights, etc.

Existing laws.

SEC. 3. That all railroad companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of railway trains over the same, and over the approaches thereto, upon the payment of a reasonable compensation for such use; and in case the owner or owners of said bridge and the several railway companies, or any one of them desiring such use, shall fail to agree upon the sum or sums to be paid, and upon rules and conditions to which each shall conform in using said bridge all matters in issue between them shall be decided by the Secretary of War upon the hearing of the allegations and proofs of the parties.

Use by other companies.

Secretary of War to decide.

SEC. 4. That said company shall submit to the Secretary of War for his examination and approval the design and drawings of the bridge and a map of the location, giving the topography of the banks of the river, the shore-lines at high and low water, the direction and strength of the current at all stages, and the soundings, accurately showing the bed of the stream, and if the Secretary of War, upon an examination of the papers to him submitted, shall require any change in the location or plans of said bridge, or its entire removal, the company shall, at its own expense, comply with such requirements; and if any change be made in the plan of said bridge such change shall be subject to the approval of the Secretary of War; and if any litigation shall be had in regard to said bridge, by reason of said bridge being alleged to be an obstruction to the navigation of said Coosa River, the same shall be in the circuit court of the United States in whose territorial jurisdiction said bridge or any part thereof is located.

Secretary of War to approve plans, etc.

Litigation.

SEC. 5. That the right to alter, amend, or repeal this act is hereby expressly reserved, and any alterations or changes that may be required by the Secretary of War in the bridge constructed under this act shall be made by the corporation owning or controlling the same at its own expense.

Amendment, etc.

Approved, March 1, 1889.

CHAP. 357.—An act to authorize the construction of a bridge for railway purposes across the Mississippi River between the States of Wisconsin and Minnesota, to be located north of and in the vicinity of the city of Alma, Wisconsin.

March 2, 1889.
Vol. 25, p. 788.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Soo and Southwestern

Second South-
western Rail-
way Company
may bridge Mis-
sissippi River at
Alma, Wis.

Proviso.
Tolls, etc.
Draw.

Spans.

Provisos.
Location of
of spans.

Size.

Opening draw.

Lights, etc.

Aids to navi-
gation.

Secretary of
War to approve
plans, etc.

Provisos.

Changes.

Not to obstruct
navigation.

Lawful struct-
ure and post-
route.

Railroad Company, a corporation organized under the laws of the State of Wisconsin, and its successors and assigns, be, and they are hereby, authorized to construct and maintain railway bridge and approaches thereto across the Mississippi River between the States of Wisconsin and Minnesota from a point just north of the Beef Slough cut-off, in section twenty-one, township number twenty-two north, of range thirteen west, of the fourth principal meridian, above the city of Alma, in the county of Buffalo, Wisconsin, to and upon the west bank of said river, in the county of Wabasha, in the State of Minnesota: *Provided*, That Congress may at any time pre-cribe such rules and regulations in regard to toll and otherwise as may be deemed reasonable.

SEC. 2. That said bridge shall be built with a draw, so as not to impede the navigation of said river; said draw shall be a pivot-draw, over the channel of said river usually navigated, near the Wisconsin shore, and giving a clear width of water-way of not less than two hundred feet on each side of the central or pivot pier of the draw, and in addition to said draw opening shall have one or more fixed channel-spans, each having not less than three hundred and fifty feet clear channel-way, and every part of the superstructure of said bridge shall give a clear head-room of not less than ten feet above high-water mark: *Provided*, That all spans shall be so located as to afford the greatest possible accommodation to the river traffic, and a draw opening shall, if practicable, be located next or near shore: *Provided, also*, That if the physical characteristics of the locality so require and the interests of navigation be not injured thereby, the lengths of the fixed spans or the number of draw-openings may be reduced: *Provided, also*, That for every two adjacent openings of two hundred feet each, one draw opening of three hundred feet may be substituted if the interests of navigation be not injured thereby: *Provided*, That said draw shall always be opened promptly upon reasonable signal, and said corporation shall maintain at its own expense, from sunset to sunrise, such lights or other signals on said bridge as the Light-House Board shall prescribe: *And provided further*, That no bridge shall be built under the provisions of this act except there also be built at the time of the erection of the piers proper sheer-booms, or other proper protections, to safely guide boats, vessels, rafts, and other water-craft through said draw-spans and the raft-spans of said bridge.

SEC. 3. That any bridge authorized to be constructed under this act shall be built and located under and subject to such regulations for the security of navigation on said river as the Secretary of War shall prescribe; and to secure that object the said corporation shall submit to the Secretary of War, for his examination and approved, a design and drawings of the bridge and a map of the location, giving, for the space of one mile above and one mile below the proposed location, the topography of the banks of the river, the shore-lines at extreme high and low water, the direction and strength of the currents at all stages, and the soundings, accurately showing the bed of the stream, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and said bridge shall not be built until the plan and location thereof are approved by the Secretary of War, but when so approved the work on said bridge and the approaches thereto, and the accessory works, may be commenced and prosecuted to completion: *Provided*, That as nearly as practicable the said bridge shall be at right angles to, and the piers parallel with, the current of said river: *And provided further*, That any change in the mode of construction of said bridge shall be first submitted to the said Secretary for his approval, and when approved the said corporation may then proceed with the construction in accordance with said change. *And provided, also*, That if said bridge when constructed shall, in the opinion of the Secretary of War, be a substantial obstruction to the navigation of said river, the said Secretary shall require said corporation to change the construction thereof, or to remove the same entirely, so as to avoid any serious and substantial obstruction to the navigation of said river at the expense of the owners of said bridge.

SEC. 4. That the bridge hereby authorized shall be a lawful structure, and shall be a post-route upon which no higher charge shall be made for the transportation of the mails of the United States and the troops and munitions of war, or for passengers or freight passing over said bridge, than the rate per mile paid to railroads and transportation companies leading to said bridge, and it shall enjoy the rights and

privileges of other post-roads in the United States, and the United States shall have the right of way for postal-telegraph purposes across said bridge.

SEC. 5. That all railroad companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of railway trains or cars over the same, and over the approaches thereto, upon payment of a reasonable compensation for such use; and in case the owner or owners of said bridge and the several railroad companies, or any of them, desiring such use, shall fail to agree upon the sum or sums to be paid, and upon rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War upon a hearing of the allegations and proofs of the parties: *Provided*, That the provisions of section four, in regard to charges for passengers and freight across said bridge, shall not govern the Secretary of War in determining any question arising as to the sum or sums to be paid to the owners of said bridge by said railroad companies for the use of said bridge.

Postal telegraph.

Use by other companies.

Terms.

Secretary of War to decide. *Proviso.*

Determining compensation.

SEC. 6. That this act shall be subject, except as above mentioned, to the limitations and provisions of an act entitled "An act to authorize the construction of a bridge across the Mississippi River at or near the town of Clinton, in the State of Iowa, and other bridges across said river, and to establish them as post-roads," approved April first, eighteen hundred and seventy-two.

General provisions applicable. V ol. 7, p. 44.

SEC. 7. That the right to alter, amend, or repeal this act is hereby expressly reserved; and the right to require any change in such structure, or its entire removal, at the expense of the owners thereof, whenever Congress shall decide that the public interests require it, is also expressly reserved.

Amendment, etc.

SEC. 8. That it shall be the duty of the Secretary of War, on satisfactory proof that a necessity exists therefor, to require the corporation or persons owning said bridge to cause such aids to the passage of said bridge to be constructed, placed, and maintained at their own cost and expense in the form of booms, dikes, piers, or other suitable or proper structures for the guiding of rafts, steam-boats, and other water-craft safely through the passage-way as shall be specified in his order in that behalf; and on failure of the corporation or persons aforesaid to make and establish such additional structures within a reasonable time, the said Secretary shall proceed to cause the same to be built or made at the expense of the United States, and shall refer the matter without delay to the Attorney-General of the United States, whose duty it shall be to institute, in the name of the United States, proceedings in any of the circuit courts of the United States, within the jurisdiction of which such bridge, or any part thereof is or may be located, for the recovery of the cost thereof; and all monies accruing from such proceedings shall be covered into the Treasury of the United States.

Aids to navigation.

To be established by Secretary of War on failure.

Suits for costs.

SEC. 9. That this act shall be null and void, if actual construction of the bridge herein authorized be not commenced within two years, and completed within four years, from the date thereof.

Commencement and completion.

Approved, March 2, 1889.

CHAP. 262.—An act to authorize the Union Gas Company to lay conduit pipes across the Ohio River.

March 2, 1889. Vol. 25, p. 791.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the assent of congress is hereby given to the Union Gas Company to lay pipes for conducting natural gas, petroleum, or salt water across the Ohio River at such points as may be deemed necessary, between the mouth of Buck Creek, in Harrison County, Indiana, and the city of Jeffersonville, Indiana, and points opposite thereto in the State of Kentucky, from any point in said State to the upper boundary of the city of Louisville, Kentucky: *Provided*, That said pipes be laid upon or beneath the bed of the river and in such manner as not to interfere with navigation, and under the supervision of the Secretary of War.

Union Gas Company. May lay pipes across Ohio River, Jeffersonville, Ind., to Louisville, Ky.

Proviso. Not to obstruct navigation.

Approved, March 2, 1889.

430 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

March 2, 1889. CHAP. 365.—An act to authorize the city of Lake View, Illinois, to erect a crib in Lake Michigan for waterworks purposes

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the consent of Congress is hereby given to the city of Lake View, county of Cook and State of Illinois, to extend a tunnel, or inlet pipes, into Lake Michigan so far as may be deemed necessary to insure a supply of pure water, and to erect a pier or piers and crib in the navigable waters of said lake, for the making, preserving, and working of said aqueducts or pipes or tunnel, the plan and location thereof to be subject to the approval of the Secretary of War: *Provided,* That said city shall furnish and maintain at its own expense such beacon lights or other signals on such piers or crib as the Light House Board shall prescribe.

Approved, March 2, 1889.

March 2, 1889. CHAP. 370.—An act making appropriations to provide for the expenses of the government of the District of Columbia for the fiscal year ending June thirtieth, eighteen hundred and ninety, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the half of the following sums named, respectively, is hereby appropriated, out of any money in the Treasury not otherwise appropriated, and the other half out of the revenues of the District of Columbia, for the purposes following, being for the expenses of the government of the District of Columbia for the fiscal year ending June thirtieth, eighteen hundred and ninety, namely:

GENERAL EXPENSES.

Salaries, etc.

FOR SALARIES AND CONTINGENT EXPENSES.

EXECUTIVE OFFICE: For * * * one Engineer Commissioner, nine hundred and twenty-four dollars (to make salary five thousand dollars);

* * * * *

Aqueduct

WASHINGTON AQUEDUCT.

For engineering, maintenace, and general repairs, twenty thousand dollars.

* * * * *

Approved, March 2, 1889.

March 2, 1889. CHAP. 372.—An act making appropriations for the support of the Army for the fiscal year ending June thirtieth, eighteen hundred and ninety, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and they are hereby, appropriated, out of any money in the Treasury not otherwise appropriated, for the support of the Army for the year ending June thirtieth, eighteen hundred and ninety:

* * * * *

Engineer Department.

ENGINEER DEPARTMENT.

Engineer depot at Willets' Point, New York: Incidental expenses of the depot, including fuel, chemicals, stationery, extra-duty pay to soldiers employed for periods of not less than ten days as artificers on work in addition to and not strictly in line of their military duties, such as carpenters, blacksmiths, draughtsmen, printers, lithographers, photographers, engine-drivers, teamsters, repairs of and for materials to repair public buildings, machinery, and unforeseen expenses, five thousand dollars,

For purchase of materials for the instruction of engineer troops at Willet's Point in their special duties of sappers and miners, for land submarine mines, and pontooners, torpedo drill and signaling, one thousand five hundred dollars.

For purchase and repairs of instruments to be issued to officers of the Corps of Engineers, for use on public works and surveys, four thousand dollars.

Library of the Engineer School of Application: Purchase and binding of professional works of recent date treating of military and civil engineering; five hundred dollars.

For a building to contain engineer models, eight thousand dollars, or so much thereof as may be necessary. New buildings

Approved, March 2, 1889.

CHAP. 376.—An act authorizing the construction of a high wagon-bridge across the Missouri River at or near Sioux City, Iowa. March 2, 1889.
Vol. 25, p. 849.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That it shall be lawful for the city of Sioux City, Iowa, to construct and maintain a high wagon-bridge across the Missouri River, at or near the city of Sioux City, in the State of Iowa, so as to connect with the opposite shore of the said river in the State of Nebraska, for the passage of wagons and vehicles of all kinds, for the transit of animals and for foot-passengers, for such reasonable rates of toll as the city of Sioux City, Iowa, may, from time to time prescribe, subject to the approval of the Secretary of War: *Provided*, That said bridge shall not be built or commenced until the plan and specifications for its construction have been submitted to the Secretary of War for his approval, nor until he shall approve the plan and location of said bridge; and if any change be made in the plan of construction of said bridge at any time, such change shall be subject to the approval of the Secretary of War; and any change in the construction, or any alteration of said bridge that may be directed at any time by Congress or the Secretary of War, shall be made at the cost and expense of the owners thereof.

Sioux City,
Iowa, may bridge
Missouri River.

Wagon and
foot bridge.

Provided,
Submission of
plans.

SEC. 2. That the said bridge shall be constructed without interference with the security and convenience of navigation of said river beyond what is necessary to carry into effect the rights and privileges hereby granted; and in order to secure that object the said corporation shall submit to the Secretary of War, for his examination and approval a design of and drawings for said bridge, and a map of the proposed location, giving, for the space of one mile above and one mile below such proposed location, the topography of the banks of the river, with shore-lines and soundings, and such other information as may be required for a full understanding of the subject; and until the said plan and location of the bridge are approved by the Secretary of War the construction of said bridge shall not be commenced: *Provided*, That if the said bridge shall be made with unbroken and continuous spans, it shall have three or more channel spans, and shall not be of less elevation in any case than fifty feet above extreme high-water mark, as understood at the point of location, to the lower part of the superstructure of the bridge, nor shall the spans of said bridge be less than three hundred feet in length, and the main span shall be over the main channel of the river, and the piers of said bridge shall be parallel with the current of said river, and the bridge itself at right angles thereto: *And provided, also*, That if any bridge built under this act be constructed as a draw-bridge, it shall have a draw over the main channel of the river at an accessible and navigable point, and with a span or spans not less than three hundred feet in length in the clear; and no river spans shall be less than three hundred feet in length in the clear and the head-room under such spans shall not be less than ten feet above extreme high water mark; and the piers of said bridge shall be parallel with the current of said river, and the bridge itself at right angles thereto; that said draw shall be opened promptly upon reasonable signal for the passing of boats, barges, or rafts, and said company or corporation shall maintain, at its own

Unobstructed
navigation.

Secretary of
War to approve
plans, etc.

Provided,
Spans.

Draw.

Lights, etc.	expense, from sunset to sunrise, such lights or other signals on said bridge as the Light-House Board shall prescribe
Notification of approval.	SEC. 3. That the Secretary of War is hereby authorized and directed, upon receiving such plan and other information, and upon being satisfied that a bridge so built will conform to the requirements of this act, to notify the company or corporation authorized to build the same that he approves of the same; and upon receiving such notification the said company or corporation may proceed to erect said bridge, conforming strictly to the approved plan and location; and should any change be made in the plan of the bridge or accessory works during the progress of the work thereon, such change shall be subject likewise to the approval of the Secretary of War.
Lawful structure and post-route.	SEC. 4. That said bridge and accessory works, when built and constructed under this act and according to the terms and limitations thereof, shall be lawful structures; and said bridge shall be recognized and known as a post-route, upon which also no higher charge shall be made for the transmission over the same of the mails, the troops, and the munitions of war of the United States than the rate per mile paid for the transportation over the highways leading to said bridge; and said bridge shall enjoy the rights and privileges of other post-routes in the United States; and Congress reserves the right at any time to regulate by appropriate legislation the charges for freight and passengers over said bridge.
Postal telegraph.	SEC. 5. That the United States shall have the right of way for such postal telegraph lines across said bridge as the Government may construct or control, and equal privileges in the use of said bridge shall be granted to all telegraph companies.
Amendment, etc.	SEC. 6. That Congress shall have power at any time to alter, amend, or repeal this act, and the Secretary of War, whenever he deems it necessary, may cause the owners of said bridge to remove all material and substantial obstructions to the navigation of said river by the construction of said bridge and its accessory works, or to prevent such obstructions; and the expense of altering said bridge or removing such obstructions shall be at the expense of the owners of such bridge.
Commencement and completion.	SEC. 7. That this act shall be null and void if construction of said bridge shall not be commenced within two years and be finished within four years from its passage.
Approved, March 2, 1889.	

March 2, 1889.
Vol. 25, p. 864.

CHAP. 387.—An act to establish a railway bridge across the Illinois River, between a point within five miles of Columbiana, in Greene County, and a point within five miles of Kampsville, in Calhoun County, in the State of Illinois.

Litchfield Carrollton and Western Railroad Company may bridge Illinois River between Columbiana and Kampsville, Ill.	<i>Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,</i> That the Litchfield, Carrollton and Western Railroad Company, a corporation organized under the laws of the State of Illinois, its successors and assigns, are hereby authorized and empowered to erect, establish, and maintain a railway bridge across the Illinois River, between a point to be by them selected within five miles of Columbiana, in Greene County, and a point to be selected by them, within five miles of Kampsville, in Calhoun County, in the State of Illinois; and that said bridge shall not interfere with the free navigation of said river, and in case of any litigation arising from any obstruction or alleged obstruction to the free navigation of said river, the same shall be instituted and determined in the district court of the United States for the southern district of the State of Illinois.
Litigation.	
Construction.	SEC. 2. That any bridge built under the provisions of this act may, at the option of the company building the same, be built as a draw-bridge, with a pivot or other form of draw, or with unbroken or continuous spans: <i>Provided</i> , That if the said bridge shall be built with unbroken or continuous spans it shall have one or more channel spans, each having not less than three hundred and fifty feet clear channel-way, and not less than fifty-five feet clear head-room above high-water mark, and the clear head-room under the other channel spans may be less than fifty-five feet: <i>Provided</i> , That no part of the superstructure of such spans shall give a less head-room than ten feet above high-water
Proviso. Spans.	

mark: *And provided further*, That the interests of navigation be not injured by such reduction in height; and the piers of said bridge shall be parallel with the current of said river, and the main span shall be over the main channel of the river, and not less than three hundred and fifty feet in length: *And provided also*, That if any bridge built under this act shall be constructed as a draw-bridge, the same shall be constructed as a pivot draw-bridge, with a draw over the main channel of the river at an accessible and navigable point and with spans of not less than one hundred and sixty feet in length on each side of the central or pivot-pier of the draw; and the next adjoining spans to the draw shall not be less than three hundred and fifty feet in length; and every part of the superstructure shall give a clear head-room of not less than ten feet above high-water mark: *Provided*, That the spans of both high and low bridges shall be so located as to afford the greatest possible accommodations to the river traffic, and a draw-opening of low bridges shall, if practicable, be located next or near shore; and the piers of said bridge shall be parallel with the current of the river when said bridge may be erected: *And provided also*, That said draw shall be opened promptly upon reasonable signal for the passage of boats.

SEC. 3. That any bridge constructed under this act and according to its limitation shall be a lawful structure, and shall be known and recognized as a post-route, and the same is hereby declared to be a post-route, upon which also no higher charge shall be made for the transmission over the same of the mails, the troops, and the munitions of war of the United States than the rate per mile paid for their transportation over the railroads and public highways leading to the said bridge, and the United States shall have the right of way for a postal telegraph across said bridge.

SEC. 4. That all railway companies desiring to use said bridge shall have and be entitled to equal rights and privileges in the passage of the same and in the use of the machinery and fixtures thereof, and of the approaches thereto, under and upon such terms and conditions as shall be prescribed by the Secretary of War upon hearing the allegations and proofs of the parties in case they shall not agree.

SEC. 5. That the structure herein authorized shall be built and located under and subject to such regulations for the security of navigation of said river as the Secretary of War shall prescribe; and to secure that object the said company or corporation shall submit to the Secretary of War for his examination and approval a design and drawings of said bridge and a map of the location, giving, for the space of one mile above and one mile below the proposed location, the topography of the banks of the river, the shore lines at high and low water, the direction and strength of the current at all stages, and the soundings, accurately showing the bed of the stream, the location of any other bridge or bridges, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and until the said plan and location of the bridge are approved by the Secretary of War the bridge shall not be commenced or built, and should any change be made in the plan of said bridge during the process of construction such change shall be subject to the approval of the Secretary of War; and the said structure shall be at all times so managed and kept as to offer reasonable and proper means for the passage of vessels through or under said structure; and to secure the safe passage of vessels at night there shall be displayed on said bridge, from the hour of sunset to that of sunrise, such lights as may be prescribed by the Light-House Board, and the said structure shall be changed, at the cost and expense of the owners thereof, from time to time, as the Secretary of War may direct, so as to preserve the free and convenient navigation of said river.

SEC. 6. That this act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date thereof.

SEC. 7. That the right to alter, amend, or repeal this act is hereby expressly reserved.

SEC. 8. That this act shall take effect and be in force from and after its passage.

Approved, March 2, 1889.

ENG 89—28

Height.
Unobstructed
navigation.

Draw.

Location of
spans, etc.

Opening draw.

Lawful structure
and post-
route.

Postal tele-
graph.

Use by other
companies.

Terms.

Secretary of
War to approve
location, etc.

Changes.

Lights, etc.

Commencement
and completion.

Amendment.

Effect.

March 2, 1889. CHAP. 388.—An act to authorize the Montgomery and Sylacauga Railroad Company to construct a bridge across the Tallapoosa River.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Montgomery and Sylacauga Railroad Company, organized under the laws of the State of Alabama, be, and is hereby, authorized to construct and maintain a bridge, and approaches thereto, over the Tallapoosa River at or near Judkin's Ferry, in the State of Alabama. Said bridge shall be constructed to provide for the passage of railway trains, and, at the option of the corporation by which it may be built, may be used for the passage of wagons and vehicles of all kinds, for the transit of animals, and for foot-passengers.

Railway wagon, and foot bridge.

Lawful structure and post-route.

Postal telegraph.

Use by other companies.

Compensation.

Secretary of War to decide.

Secretary of War to approve plans, etc.

Amendment.

Commencement and completion.

SEC. 2. That any bridge built under this act and subject to its limitations shall be a lawful structure, and shall be recognized and known as a post-route, and it shall enjoy the rights and privileges of other post-roads in the United States, and equal privileges in the use of said bridge shall be granted to all telegraph and telephone companies; and the United States shall have the right of way over said bridge for postal telegraph purposes.

SEC. 3. That all railroad companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of railway trains over the same, and over the approaches thereto, upon the payment of a reasonable compensation for such use; and in case the owner or owners of said bridge and the several railroad companies, or any of them, desiring such use, shall fail to agree upon the sum or sums to be paid, and upon rules or conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War upon a hearing of the allegations and proofs of the parties.

SEC. 4. That the bridge authorized to be constructed under this act shall be built and located under and subject to such regulations for the security of navigation of said river as the Secretary of War shall prescribe; and to secure that object the said company or corporation shall submit to the Secretary of War, for his examination and approval, a design and drawings of the bridge, and a map of the location, giving, for the space of one mile above and one mile below the proposed location, the topography of the banks of the river, the shorelines at high and low water, the direction and strength of the currents at all stages, and the soundings, accurately showing the bed of the stream, the location of any other bridge or bridges, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and until the said plan and location of the bridge are approved by the Secretary of War the bridge shall not be commenced or built, and should any change be made in the plan of said bridge during the progress of construction such changes shall be subject to the approval of the Secretary of War; and the expense of such change and of any other changes at any time required by the Secretary of War in said bridge, or its entire removal after being completed, if the Secretary deems the same necessary, shall be paid by the persons or corporation owning or controlling said bridge.

SEC. 5. That the right to alter, amend, or repeal this act is hereby expressly reserved.

SEC. 6. That this act shall be null and void if actual construction of the bridge herein authorized be not commenced within two years and completed within three years from the date thereof.

Approved, March 2, 1889.

March 2, 1889. CHAP. 389.—An act to grant to the Gulf and Chicago Air-Line Railway Company the right to construct bridges over the Tombigbee, Warrior, and Tennessee Rivers, and across Grand Pass to Dauphin's Island, in the Gulf of Mexico.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Gulf and Chicago Air-Line Railway Company, a corporation duly organized and legally incorporated under the laws of the State of Alabama, its successor or legal representative, may erect a bridge over the Tombigbee River at such point in the vicinity of Coffeyville, in Clarke County, as surveys and examinations may establish to be the best and most advantageous

Gulf and Chicago Air-Line Railway Company may bridge Tombigbee River, Ala.

point for crossing said river. Said corporation, its successor or legal representative, may also construct bridges over the Warrior River at or near Tuscaloosa, and the Tennessee River at or near Milton's Bluff; and for purposes of reaching a terminal point and uninterrupted navigation at deep water on the Gulf of Mexico, said railway company may construct and extend its line from its present terminus at Cedar Point, in said State of Alabama, across Grant Pass and the shoal waters intervening, to Dauphin's Island, in the Gulf of Mexico; and for such purposes may construct, operate, and maintain such tramways, tracks, road-beds, bridges, and terminal facilities at and between said Dauphin's Island and Cedar Point, or in vicinity thereof, as are necessary for use of said railway in the common course and conduct of its business.

Warrior River,
at Tuscaloosa.
Tennessee River,
at Milton's
Bluff.

Grant Pass to
Dauphin's Isl-
and.

SEC. 2. That any bridge built under the provisions of this act may, at the option of said Railway Company, be built as a draw-bridge or with unbroken and continuous spans: *Provided*, That if any such bridge shall be made with unbroken and continuous spans, the main span shall be over the main channel of such navigable river or pass, and shall be of such width, and the lowest part of the superstructure shall be of such height above extreme high-water mark, as the Secretary of War may prescribe; and such bridge shall be at right angles to and its piers parallel with the current or channel of the river or pass over which it may be constructed; and if any bridge built under this act shall be constructed as a draw-bridge, the same shall be constructed with an opening over the center of the channel of the river or pass, and shall be of such width, character, and construction as the Secretary of War shall prescribe, and the piers of said bridge shall be parallel with the current, and the draw of said bridge shall be over the main or deep channel of the river or pass, as may be fixed and determined by the Secretary of War: *Provided also*, That the said draws shall be opened promptly upon reasonable signal for the passage of boats, and in no case shall unnecessary delay occur; and said company or corporation shall maintain, at its own expense, from sunset to sunrise, such lights or other signals on said bridges as the Light House Board shall prescribe: *And provided also*, That said bridges, at the option of the Corporation or Company by which they may be built, may be used for the passage of wagons or vehicles of all kinds, for the transit of animals, and for foot-passengers, for such reasonable rate of toll as may be approved from time to time by the Secretary of War.

Construction.

Provides.
Spans.

Draws.

Opening draws.

Lights, etc.

May be wagon
and foot bridges.
Toll.

SEC. 3. That any bridge authorized to be constructed under this act shall be a lawful structure, and shall be recognized and known as a post-route, and it shall enjoy the rights and privileges of other post-roads in the United States, upon which also no higher charge shall be made for the transmission over the same of the mails, the troops, and munitions of war of the United States, or for through passengers or freight passing over said bridge or bridges, than the rate per mile for their transportation over the railroads leading to the said bridge or bridges; and equal privileges in the use of said bridges shall be granted to all telegraph companies and the United States shall have the right of way for a postal telegraph across said bridge or bridges. Said bridge or bridges, and the construction and extension of the line from its present terminus at Cedar Point across to Dauphin's Island, and the terminal facilities at and between Dauphin's Island and Cedar Point, where they project into navigable water, shall be built and located under and subject to such regulations for the security of navigation of navigable rivers and waters as the Secretary of War shall prescribe; and to secure that object the said company or corporation shall submit to the Secretary of War, for his examination and approval, a design and drawing of any such bridges or constructions, and a map of location, giving, for the space of one mile above and one mile below the proposed location, the topography of the banks of the river, and shores of Mobile Bay, Gulf of Mexico, Mississippi Sound, or strait connecting Mobile Bay and Mississippi Sound, the shore-lines at high and low water, the direction and strength of the current at all stages, and the soundings, accurately showing the bed and channel of the stream, the location of any other bridge or bridges, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and until the said plans and location of the bridge or bridges or constructions are approved by the Secretary of War the bridge or constructions shall not be built; and should any change be

Lawful structure
and post-
routes.

Postal tele-
graph.

Secretary of
War to approve
plans, etc.

Changes.

	made in the plan of any such bridge or construction during the progress of construction thereof, such change shall be subject to the approval of the Secretary of War.
Use by other companies.	SEC. 4. That all railroad companies desiring the use of any bridge constructed under this act shall have and be entitled to equal rights and privileges relative to the passage of railways trains or cars over the same, and over the approaches thereto, upon payment of a reasonable compensation for such use; and in case the owner or owners of said bridge and the several railroad companies, or any one of them, desiring such use shall fail to agree upon the sum or sums to be paid and upon rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War, upon a hearing of the allegations and proofs of the parties.
Compensation.	
Decision by Secretary of War.	
Alterations.	SEC. 5. That such alterations or changes as may be required by the Secretary of War or Congress in bridges or other structures built under the provisions of this act shall be made by the persons or corporations owning or controlling said bridges or structures at their own expense; and if any litigation shall arise in regard to said bridges, or either of them, by reason of their obstructing navigation, the same shall be had in the circuit court of the United States within whose territorial jurisdiction said bridges or any part thereof may be located; and it is hereby expressly provided that Congress reserves the right at any time to alter, amend, or repeal this act.
Litigation.	
Amendment.	
Right of way, etc., military reservation, Dauphin's Island.	SEC. 6. No tramway, track, road-bed, wharf, pier, or other structure shall be built upon the United States military reservation on Dauphin's Island, without the approval and consent of the Secretary of War first had, and the said structure shall be removed by the parties owning or controlling the same, at their own expense, when the Secretary of War so requires: <i>Provided, also</i> , That the United States may use such structure when built without charge.
Proviso.	
Use by Government.	SEC. 7. That this act shall be null and void if actual construction of the bridge or bridges herein authorized be not commenced within one year and completed within three years from the date thereof.
Commencement and completion.	

Approved, March 2, 1889.

March 2, 1889. CHAP. 397.—An act to authorize the Natchitoches Railroad Company to construct and maintain a bridge across the Red River, in Louisiana.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Natchitoches Railroad Company, a corporation created and existing under and by virtue of the laws of the State of Louisiana, be, and is hereby, authorized to construct and maintain a railroad and wagon bridge across the Red River at such point as may be selected by the said railroad company in the parish of Natchitoches or in the parish of Red River, the said bridge to be so constructed as not to interfere with the navigation of said river, and to be provided with a suitable draw: *Provided*, That any bridge constructed under this act and according to its limitations shall be a lawful structure, and shall be known and recognized as a post-route, and the same is hereby declared to be a post-route, upon which also no higher charge shall be made for the transmission over the same of the mails, the troops, and the munitions of war of the United States, or for through passengers or freight passing over said bridge, than the rate per mile paid for their transportation over the railroads leading to the said bridge; and equal privileges in the use of said bridge shall be granted to all telegraph companies; and the United States shall have the right of way for a postal telegraph across said bridge.

SEC. 2. That the bridge authorized to be constructed under this act shall be located and built under and subject to such regulations for the security of the navigation of said river as the Secretary of War shall prescribe; and to secure that object the said company or corporation shall submit to the Secretary of War, for his examination and approval, a design and drawings of the proposed bridge, and a map of the location, giving, for the space of one mile above and one mile below the proposed location, the topography of the banks of the river, the shore-lines at high and low water the direction and strength of the currents, and the soundings, accurately showing the bed of the stream, and shall

furnish such other information as may be required for a full and satisfactory understanding of the subject; and until the said plan and location of the bridge are approved by the Secretary of War no work upon the bridge shall be commenced; and should any change be made in the plan of said bridge during the progress of construction, such change shall be subject to the approval of the Secretary of War.

SEC. 3. That Congress reserves the right to alter, amend, or repeal this act at any time; and that if at any time navigation of said river shall in any manner be obstructed or impaired by the said bridge, the Secretary of War shall have authority, and it shall be his duty, to require the said railroad company to alter and change the said bridge at its own expense, in such manner as may be proper to secure free and complete navigation without impediment; and if upon reasonable notice to said railroad company to make such change or improvements the said company fails to do so, the Secretary of War shall have authority to make the same at the expense of said company, and all the rights conferred by this act shall be forfeited; and Congress shall have power to do any and all things necessary to secure the free navigation of the river.

Amendment.

Changes.

Free navigation.

SEC. 4. That said company shall be permitted to charge and take such rates of toll for crossing said bridge, as may be reasonable, subject to the approval of the Secretary of War.

Toll.

SEC. 5. That the draw provided for the bridge herein authorized to be constructed shall be opened promptly upon reasonable signal for the passing of boats; and said company or corporation shall maintain, at its own expense, from sunset till sunrise, such lights or other signals on said bridge as the Light House Board shall prescribe.

Opening draws.

Lights, etc.

SEC. 6. That all railroad companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of railway trains over the same, and over the approaches thereto, upon payment of a reasonable compensation for such use; and in case the owner or owners of said bridge and the several railroad companies, or any one of them, desiring such use, shall fail to agree upon the sum or sums to be paid, and upon rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War, upon a hearing of the allegations and proofs of the parties; and if said bridge is not commenced within three years and completed within five years from the passage of this act the rights and privileges hereby granted shall be null and void.

Use by other companies.

Compensation.

Decision by Secretary of War.

Commencement and completion.

Approved, March 2, 1889.

CHAP. 388.—An act to authorize the construction of a bridge over the Saint John's River in the State of Florida.

March 2, 1889.
Vol. 25, p. 880.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Saint John's and Halifax River Bridge Company be, and is hereby, authorized to construct a bridge over the river Saint John's, in the county of Putnam and State of Florida, at or near the city of Palatka.

SEC. 2. That said bridge shall be constructed with a draw, so that a free and unobstructed passage may be secured to all vessels and other water-craft navigating said river.

Saint John's and Halifax River Bridge Company may bridge Saint John's River at Palatka.

Unobstructed navigation.

SEC. 3. That any bridge built under this act, and subject to its limitations, shall be a lawful structure, and shall be recognized and known as a post-route, upon which also no higher charge shall be made for the transmission over the same of the mails, the troops, and the munitions of war of the United States, or passengers or freight passing over said bridge, than the rate per mile paid for the transportation over the railroads or public highways leading to the said bridge; and it shall enjoy the rights and privileges of other post-roads in the United States; and equal privileges in the use of said bridge shall be granted to all telegraph companies, and the United States shall have right of way over said bridge for postal telegraph purposes.

Lawful structure and post-route.

Postal telegraph.

SEC. 4. That the draw shall be opened promptly upon reasonable signal for the passage of boats, and said company or corporation shall maintain at its own expense, from sunset till sunrise, such lights or other signals on said bridge as the Light-House Board shall prescribe. No bridge shall be erected or maintained under the authority of this

Opening draw.

Lights, etc.

Changes, etc.	act which shall at any time substantially or materially obstruct the free navigation of said river, and if any bridge erected under such authority shall, in the opinion of the Secretary of War, obstruct such navigation, he is hereby authorized to cause such change or alteration of said bridge to be made as will effectually obviate such obstruction, and all such obstructions shall be removed, and alterations made, at the expense of the owner or owners of said bridge: <i>Provided</i> , That nothing in this act shall be so construed as to repeal or modify any of the provisions of law now existing in reference to the protection of the navigation of rivers, or to exempt the bridge erected under this act from the operation of the same.
<i>Proviso.</i>	
Existing laws.	
Use by other companies.	SEC. 5. That all railroad companies desiring the use of said bridge shall have, and be entitled to, equal rights and privileges relative to the passage of railway trains or cars over the same, and over the approaches thereto, upon payment of a reasonable compensation for such use; and in case the owner or owners of said bridge and the several railroad companies, or any one of them desiring such use, shall fail to agree upon the sum or sums to be paid, and upon rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War upon a hearing of the allegations and proofs of the parties.
Compensation.	
Decision of Secretary of War.	
Secretary of War to approve plans, etc.	SEC. 6. That any bridge authorized to be constructed under this act shall be built and located under and subject to such regulations for the security of navigation of said river as the Secretary of War shall prescribe, and to secure that object, said company or corporation shall submit to the Secretary of War a design and drawings of said bridge to be erected, for his examination and approval and a map of its location, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject, and in all things shall be subject to such rules and regulations as may be prescribed by the Secretary of War, and until said plan and location of said bridge are approved by the Secretary of War, said bridge shall not be commenced or built; and should any change be made in the plan of any bridge authorized to be constructed by this act during the progress of the work of construction, such change shall be subject to the approval of the Secretary of War.
Amendment.	SEC. 7. That the right to alter, amend, or repeal this act is hereby expressly reserved, and the right to require any changes in said structure, or its entire removal, at the expense of the owners thereof, whenever Congress or the Secretary of War shall decide that the public interest requires it, is also expressly reserved.
Commencement and completion.	SEC. 8. That this act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date thereof.
	Approved, March 2, 1889.

March 2, 1889. CHAP. 400.—An act to authorize the construction of bridges across the Kentucky River.

Kentucky Midland Railway Company may bridge Kentucky River and tributaries.	<i>Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled</i> , That the Kentucky Midland Railway Company, a corporation organized under act of the general assembly of the Commonwealth of Kentucky, be, and it is hereby, authorized to construct and maintain a bridge, and approaches thereto, over the Kentucky River, in the State of Kentucky, and also a bridge or bridges over the tributaries or forks of said river at such point or points as said company may deem suitable for the passage of its said road over said river or its tributaries or forks. Said bridge or bridges shall be constructed to provide for the passage of railway trains, and, at the option of the company by which it or they may be built, may be used for the passage of wagons and vehicles of all kinds, for the transit of animals, and for foot passengers. But the rates of toll charged for the passage over said bridge of wagons, vehicles, animals, and foot passengers shall be submitted to the Secretary of War and approved by him before said company shall collect such tolls.
Railway, wagons, and foot bridges.	
Toll.	
Lawful structures and post-roads.	SEC. 2. That any bridge built under this act and subject to its limitations shall be a lawful structure, and shall be recognized and known as a post-route, and it shall enjoy the rights and privileges of other postroads in the United States, and equal privileges in the use of said

bridge shall be granted to all telegraph and telephone companies; and the United States shall have the right of way across said bridge and its approaches for postal telegraph purposes.

SEC. 3. That any bridge authorized to be constructed under this act shall be built and located under and subject to such regulations for the security of navigation of said river as the Secretary of War shall prescribe, and to secure that object the said company or corporation shall submit to the Secretary of War, for his examination and approval, a design and drawing of the bridge, and a map of the location thereof; and until the said plan and location of the bridge are approved by the Secretary of War the bridge shall not be commenced or built; and should any change be made in the plan of said bridge during the progress of construction, such change be subject to the approval of the Secretary of War, and the expense of such change, or of any change required by the Secretary of War in such bridge after its completion shall be paid by the corporation or persons owing or operating said bridge.

SEC. 4. That all railroad companies desiring the use of said bridge or bridges shall have and be entitled to equal rights and privileges relating to the passage of railway trains over the same, and over the approaches thereto, upon the payment or reasonable compensation therefor; and in case the owner or owners of said bridge or bridges and the railroad company or companies desiring the use of the same shall fail to agree upon the terms with reference to the use of same, all matters of issue between them shall be decided by the Secretary of War upon a hearing of the allegations and proofs of the parties.

SEC. 5. That this act shall be null and void if actual construction of the bridge or bridges herein authorized be not commenced within two years and completed within five years from the date thereof.

SEC. 6. That the right to alter, amend, or repeal this act is hereby expressly reserved.

Approved, March 2, 1889.

Postal telegraph.
Secretary of War to approve plans, etc.

Changes.

Use by other companies.

Compensation.

Decision by Secretary of War.

Commencement and completion.

Amendment.

CHAP. 401.—An act to authorize the construction of a bridge across the Missouri River between the city of Leavenworth, in the State of Kansas, and Platte County, in the State of Missouri. March 2, 1889. Vol. 25, p. 883.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Leavenworth and Platte County Bridge Company, a corporation duly organized and existing under the laws of the State of Kansas, its successors and assigns, be, and are hereby, authorized to construct and maintain a bridge, and approaches thereto, across the Missouri River between the city of Leavenworth, in the State of Kansas, and Platte County, in the State of Missouri, at some point at least one-fourth of a mile from any other bridge, to be selected consistent with the interests of river navigation. Said bridge shall be constructed to provide for the passage of railway trains, wagons, and vehicles of all kinds, steam and street cars, animals, foot-passengers, and for all road travel, for such reasonable rates of toll and under such reasonable rules and regulations as may be prescribed by said corporation, its successors and assigns, and to be approved from time to time by the Secretary of War.

SEC. 2. That any bridge built under this act and subject to its limitations shall be a lawful structure, and shall be recognized and known as a post-route, upon which also no higher charge shall be made for the transmission over the same of the mails, the troops, and the munitions of war of the United States than the rate per mile paid for the transportation over the railroad or public highways leading to the said bridge, and it shall enjoy the rights and privileges of other post-roads in the United States; and equal privileges in the use of said bridge shall be granted to all telegraph companies; and the United States shall have the right of way across said bridge and its approaches for postal-telegraph purposes.

SEC. 3. That said bridge shall be constructed as a ponton draw-span bridge, and shall contain a ponton draw-span of not less than four hundred feet in length, which draw-span shall be maintained over the main channel of the river at an accessible and navigable point, and the piers of said bridge shall be parallel with, and the bridge itself at

Leavenworth and Platte County Bridge Company may bridge Missouri River at Leavenworth, Kans.
Ante, p. 601.

Railway, wagons and foot bridge.
Toll.

Lawful structure and post-route.

Postal telegraph.

Construction. Draw.

<i>Proviso.</i>	right angles to, the current of the river: <i>Provided, also,</i> That said draw
Opening draw.	shall be opened promptly by said company, upon reasonable signal, for the passage of boats and rafts, and said company or corporation shall maintain, at its own expense, from sunset till sunrise, such lights or other signals on said bridge as the Light-House Board shall prescribe. No bridge shall be erected or maintained under the authority of this act which shall at any time substantially or materially obstruct the free navigation of said river, and if any bridge erected under such authority shall, in the opinion of the Secretary of War, obstruct such navigation, he is hereby authorized to cause such change or alteration of said bridge to be made as will effectually obviate such obstruction; and all such alterations shall be made and all such obstructions be removed at the expense of the owner or owners of said bridge; and in case of any litigation arising from any obstruction or alleged obstruction, to the free navigation of said river, caused or alleged to be caused by said bridge, the case may be brought in the district court of the United States of the State of Kansas in which any portion of said obstruction or bridge may be located: <i>And provided further,</i> That nothing in this act shall be construed as to repeal or modify any of the provisions of law now existing in reference to the protection of the navigation of rivers, or to exempt this bridge from the operation of the same: <i>Provided,</i> That said company may construct a wagon and foot bridge alone, and in case of the construction of a wagon and foot bridge alone the draws shall be of the same length herein provided, and shall be of such construction as shall be approved by the Secretary of War, and shall be subject to all the provisions herein contained in respect to being promptly opened to admit of the unobstructed navigation of said river, and of keeping the same lighted as herein provided in case of railroad and wagon bridge; and in such case the provisions herein in relation to use for railroad purposes shall not apply.
Lights, etc	
Unobstructed navigation.	
Litigation.	
Existing laws.	
Wagon and foot bridge provisions.	
Use by railroad companies.	SEC. 4. That all railroad companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of railroad trains or cars over the same, and over the approaches thereto, upon payment of a reasonable compensation for such use; and in case the owner or owners of said bridge and the several railroad companies, or any one of them, desiring such use shall fail to agree upon the sum or sums to be paid upon rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War upon a hearing of the allegations and proofs of the parties.
Compensation.	
Decision by Secretary of War.	SEC. 5. That any bridge authorized to be constructed under this act shall be built and located under and subject to such regulations for the security of navigation of said river as the Secretary of War shall prescribe; and to secure that object the said company or corporation shall submit to the Secretary of War, for his examination and approval, a design and drawings of the bridge, and a map of the location, giving, for the space of one-half mile below the proposed location, the topography of the banks of the river, the shore-lines at high and low water, the direction and strength of the currents at all stages, and the soundings, accurately showing the bed of the stream, the location of any other bridge or bridges, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and until the said plan and location of the bridge are approved by the Secretary of War the bridge shall not be built; and should any change be made in the plan of said bridge during the progress of construction, such change shall be subject to the approval of the Secretary of War.
Secretary of War to approve plans, etc.	
Amendment, etc.	SEC. 6. That the right to alter, amend, or repeal this act is hereby expressly reserved. And the right to require any changes in said structure, or its entire removal, at the expense of the owners thereof, whenever the Secretary of War shall decide that the public interest requires it, is also expressly reserved.
Commencement and completion.	SEC. 7. That this act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date thereof.

Approved, March 2, 1889.

CHAP. 492.—An act to amend an act entitled "An act to authorize the Fort Smith and Choctaw Bridge Company to construct a bridge across the Poteau River in the Choctaw Nation, near Fort Smith, Arkansas."

March 2, 1889.
Vol. 25, p. 884.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That an act entitled "An act to authorize the Fort Smith and Choctaw Bridge Company to construct a bridge across the Poteau River, in the Choctaw Nation, near Fort Smith, Arkansas," approved June eighteenth, eighteen hundred and eighty-eight, be amended as follows:

Bridge across Poteau River, Ind. Ter.
Law, 1st sess. 50th Cong., p. 184.

"That the district court of the United States for the western district of Arkansas, or such other court of the United States as may have jurisdiction over the Indian Territory in which such bridge is located, shall have jurisdiction over all controversies arising between the said Fort Smith and Choctaw Bridge Company and the Choctaw tribe of Indians; and said court shall have like jurisdiction without reference to the amount in controversy over all controversies arising between the individual members of said nation or tribe of Indians and said bridge company; and, also, over all controversies which may arise between the stockholders of said company, and the company between the stockholders; and the civil jurisdiction of said courts is hereby extended within the limits of said Indian Nation without distinction to citizenship of the parties so far as the name may be necessary to carry out the provisions of this act."

Jurisdiction in litigation.

Civil jurisdiction of courts extended.

SEC. 2. That the right to alter, amend, or repeal this act is hereby expressly reserved.

Amendment, etc.

Approved, March 2, 1889.

CHAP. 493.—An act to approve and ratify the construction by the Vicksburg, Shreveport and Pacific Railroad Company of the bridge over the Red River at Shreveport, Louisiana, and the bridge over the Ouachita River at Monroe, Louisiana, and to authorize said railroad company to maintain said bridges over said water-ways, subject to certain stipulations and conditions.

March 2, 1889.
Vol. 25, p. 885.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the construction by the Vicksburg, Shreveport and Pacific Railroad Company, a corporation owning and operating a railroad in northern Louisiana from a point on the Mississippi River opposite the city of Vicksburg, Mississippi, to Shreveport, Louisiana, of the bridge over the Red River at Shreveport, Louisiana, and the bridge over the Ouachita River at Monroe, Louisiana, be, and the same hereby is, approved and ratified, subject to the stipulations and conditions hereinafter set forth.

Construction of bridges by Vicksburg, Shreveport and Pacific Railroad Company across Red River at Shreveport, La., and Ouachita River at Monroe, La., ratified.

SEC. 2. That said bridges so long as maintained according to the limitations of this act shall be lawful structures, and shall be known and recognized as post-routes, and the same are hereby declared to be post-routes, upon which no higher charge shall be made for the transmission over the same of the mails, the troops, and the munitions of war of the United States, or for through passengers or freight passing over the same than the rate per mile paid for their transportation over the railroads leading to said bridges; and the United States shall have the right of way across said bridges for a postal telegraph.

Lawful structures and post-routes.

Postal telegraph.

Draws.

SEC. 3. That said bridges shall always be provided with a suitable draw, and shall be maintained by said railroad company, and at its expense, so as not to interfere with the navigation of said rivers, and in such way as to render navigation through the same free, easy, and unobstructed.

Security of navigation.

SEC. 4. That said bridges shall be under and subject to such regulations for the security of the navigation of said rivers as the Secretary of War shall prescribe, and the present plan and structure of said bridges shall not be altered or changed except by consent of the Secretary of War, and with his approval of the proposed change or alteration.

SEC. 5. That Congress reserves the right to alter, amend, or repeal this act at any time; and that if at any time navigation of the said rivers shall in any manner be obstructed or impaired by the said bridges the Secretary of War shall have authority, and it shall be his duty, to require the said railroad company to alter and change the said bridges, at its own expense, in such manner as may be proper to secure free and complete navigation without impediment; and if upon

Amendment, etc.

Changes.

Removing ob- reasonable notice to said railroad company to make such change or im-
structions to provevements the said company fails to do so, the Secretary of War shall
navigation. have authority to make the same at the expense of said company, and

**Laws, 1st sess.
50th Cong., p.425.**

Opening draw.

Lights, etc.

Use by other companies.

Compensation.

Decision by
Secretary of
War.

Litigation.

reasonable notice to said railroad company to make such change or improvements the said company fails to do so, the Secretary of War shall have authority to make the same at the expense of said company, and all the rights conferred by this act shall be forfeited; and Congress shall have power to do any and all things necessary to secure the free navigation of the rivers; and the said railroad company in owning, operating and maintaining said bridges, shall be subject to the provisions and penalties prescribed in sections nine and ten of an act entitled "An act making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes," which was received by the President of the United States July thirty-first, eighteen hundred and eighty-eight, and not having been returned by him to the house of Congress in which it originated within the time prescribed by the Constitution of the United States, became a law without his approval.

SEC. 6. That the draw provided for the said bridges shall be opened promptly, upon reasonable signal, for the passing of boats; and said railroad company shall maintain, at its own expense, from sunset till sunrise, such lights or other signals on said bridges as the Light-House Board shall prescribe.

SEC. 7. That all railroad companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of railway trains over the same, and over the approaches thereto, upon payment of a reasonable compensation for such use; and in case the owner or owners of said bridge and the several railroad companies, or any one of them, desiring such use, shall fail to agree upon the sum or sums to be paid, and upon rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War, upon a hearing of the allegations and proofs of the parties.

SEC. 8. That on the failure of the said railroad company to obey this act and to conform to the provisions thereof any municipal corporation adjacent to said bridges, or interested in the enforcement of this act, or any other corporation, person, or persons injuriously affected by such failure, may institute suit against said railroad company, by mandamus or other appropriate proceedings, in the circuit court of the United States within the jurisdiction of which said bridges are located, in the name of the United States, upon the relation of the party complaining, to enforce the provisions of this act. Such suit shall be brought by the United States district attorney for the district within which said bridges are situated, and said court shall have full power by its judgment and decree to compel said railroad company to comply with the provisions of this law.

Approved, March 2, 1889.

March 2, 1889.
Vol 25, p. 886.

CHAP. 404.—An act making appropriations for fortifications and other works of defense, for the armament thereof, for the procurement of heavy ordnance for trial and service, and for other purposes.

Fortifications appropriations.

Under supervision of Board.

Laws, 1st sess.
50th Cong., p. 489.

**Preservation
and repair.**

Plans.

Torpedoes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the sums of money herein provided for be, and the same are hereby appropriated, out of any moneys in the Treasury not otherwise appropriated, to be expended under the direct supervision of the Board of Ordnance and Fortification, created by the fortification appropriation act approved September twenty-second, eighteen hundred and eighty-eight, and in the manner prescribed by said act, namely :

PRESERVATION AND REPAIR OF FORTIFICATIONS: For the protection, preservation, and repair of fortifications, one hundred thousand dollars.

For preparation of plans of fortifications, five thousand dollars.

TORPEDOES FOR HARBOR DEFENSE: For the purchase of submarine mines and necessary appliances to operate them for closing the channels leading to our principal sea-ports, two hundred and fifty thousand dollars.

For needful casemates and cable galleries to render it possible to operate submarine mines, two hundred and fifty thousand dollars.

For continuing torpedo experiments and for practical instruction of engineer troops in the details of the service, thirty thousand dollars.

For the purchase of movable submarine torpedoes, in the discretion of the board on ordnance and fortifications, fifty thousand dollars.

For torpedo-armed at San Francisco Harbor, twenty-two thousand dollars.

ARMAMENT OF FORTIFICATIONS: For the finishing and assembling of eight-inch, ten-inch, and twelve-inch steel guns made from forgings procured under the act of September twenty-second, eighteen hundred and eighty-eight, thirty-five thousand dollars.

Steel guns.

For the purchase of steel forgings for field and siege cannon, as follows:

For steel forgings for not less than twenty-four three and six-tenths inch field guns, twenty-four thousand dollars;

For steel forgings for not less than ten five-inch siege guns, twenty thousand dollars;

Steel forgings.

For steel forgings for not less than ten seven-inch siege howitzers, eighteen thousand dollars;

For steel forgings for not less than sixteen three and six-tenths inch field mortars, two thousand dollars;

For manufacture of field and siege cannon (finishing and assembling) within the fiscal year eighteen hundred and ninety, fourteen thousand dollars; in all, seventy-eight thousand dollars.

Field and siege guns

For the test of experimental guns procured under the act of September twenty-second, eighteen hundred and eighty-eight, namely, for one ten-inch wire wound gun, steel, twenty-eight thousand dollars; for one twelve-inch gun, steel hooped, thirty-nine thousand five hundred dollars; for procuring one ten-inch disappearing gun-carriage, thirteen thousand five hundred dollars; for gun platforms at proving ground, six thousand five hundred dollars; for projectiles for field, siege, and sea-coast guns for issue to the service, twenty-eight thousand five hundred dollars; for siege-gun powder for issue to the service, seven thousand dollars; for fuzes and implements for issue to the service, two thousand dollars; in all, one hundred and twenty-five thousand dollars.

Tests, etc.

For the alteration of barbette carriages for ten-inch smooth-bore guns to adapt them to the service of eight-inch muzzle-loading converted rifles, fifty-four thousand dollars; for the alteration of barbette carriages for fifteen-inch smooth-bore guns to adapt them to present service conditions, forty-six thousand dollars, in all one hundred thousand dollars.

Alterations, etc.

For the manufacture of carriages for twelve-inch breech-loading rifled mortars, procured under the act of September twenty-second, eighteen hundred and eighty-eight, one hundred thousand dollars.

Carriages.

For the manufacture of forty caissons and ten combined battery wagons and forges for three and two-tenths inch field guns, forty-three thousand two hundred and seventy-four dollars.

Caissons, etc.

For procuring the necessary instruments and other materials and for the proper installation of instruments for conducting the annual heavy artillery practice of the Army, twenty thousand dollars.

Artillery practice.

For repairs and improvements at the Ordnance Proving Ground, Sandy Hook, New Jersey, namely: Repairing dock and dredging, five thousand five hundred dollars; relaying roads and walks, three thousand eight hundred dollars; repairs to officers' quarters, two thousand dollars; repairs to foreman's and soldiers' quarters, two thousand six hundred dollars; repairs to office, five hundred dollars; repairs to shops and store-houses, one thousand dollars; machinery for shops, four thousand dollars; clearing ground about ranges, six hundred dollars; laying narrow gauge tramway to proof butts and targets, five thousand three hundred and twenty dollars; in all, twenty-five thousand three hundred and twenty dollars: *Provided*, That all material purchased under this act shall be of American manufacture.

Proving ground, Sandy Hook, N.J.
Repairs, etc.

Approved, March 2, 1889.

CHAP. 404.—An act authorizing the constructing of a bridge across the Osage River, at some accessible point in the county of Benton, in the State of Missouri. March 2, 1889. Vol. 25, p. 898.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Chicago, Saint Louis, City and Galveston Railway Company, an incorporation organized under the laws of the State of Illinois, its assigns or successors, is hereby authorized to construct and maintain a bridge across the River, Mo.

Chicago, Saint Louis, Kansas City and Galveston Railway Company may bridge Osage River, Mo.

	<p>Osage River at such point as may hereafter be selected by said corporation in the county of Benton, in the State of Missouri, as shall best promote the public convenience and welfare and the necessities of business and commerce, and also to construct accessory works to secure the best practicable channel-way for navigation, and to lay on and over said bridge one or more railroad tracks for the more perfect connection of any railroads that are or shall be constructed to said river at or opposite said point.</p>
Secretary of War to approve plans, etc.	<p>SEC. 2. That said bridge shall be constructed and built without interference with the security and convenience of navigation of said river; and in order to secure that object the said company or corporation shall submit to the Secretary of War, for his examination and approval a design and drawings of the bridge, and a map of the location, giving, for the space of one-half mile above and one-half mile below the proposed location, the topography of the banks of the river, the shore-lines at high and low water, the location of any other bridge or bridges, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and until the said plan and location of the bridge are approved by the Secretary of War the bridge shall not be commenced or built: <i>Provided</i>, That if the said bridge shall be built with unbroken and continuous spans they shall conform in length and height to the requirements of the Secretary of War: <i>And provided, also</i>, That if any bridge built under this act shall be constructed as a drawbridge, the same shall constructed as a pivot drawbridge, with a draw over the main channel of the river at an accessible and navigable point, and with spans of such length as the Secretary of War shall prescribe, and the head room under said bridge shall conform to the requirements of the Secretary of War:</p>
Provisos.	
Spans.	
Draw.	
Opening draw.	<p><i>Provided, also</i>, That said draw shall be opened promptly upon reasonable signal for the passing of boats; and said company or corporation shall maintain, at its own expense, from sunset till sunrise, such lights or other signals on said bridge as the Light-House Board shall prescribe: <i>Provided, also</i>, That said draw shall be opened promptly upon reasonable signal for the passing of boats; and said company or corporation shall maintain, at its own expense, from sunset till sunrise, such lights or other signals on said bridge as the Light-House Board shall prescribe: <i>Provided, also</i>, That all railroad companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of railway trains over the same, and over the approaches thereto, upon payment of a reasonable compensation for such use; and in case the owner or owners of said bridge and the several railroad companies, or any one of them, desiring such use shall fail to agree upon the sum or sums to be paid, and upon rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War upon a hearing of the allegations and proofs of the parties.</p>
Lights, etc.	
Use by other companies.	
Decision of Secretary of War.	
Notification of approval of plans, etc.	<p>SEC. 3. That the Secretary of War is hereby authorized and directed, upon receiving the plan and map and other information, and upon being satisfied that a bridge built on such plan and with such accessory works at at such locality will conform to the prescribed conditions of this act, to notify the company that he approves the same; and upon receiving such notification the said company may proceed to an erection of said bridge, conforming strictly to the approved plan and location; and should any change be made in the plan of the bridge or said accessory works during the progress of the work thereon such change shall be subject likewise to the approval of the Secretary of War; and in case of any litigation arising from any obstruction or alleged obstruction to the free navigation of said river, caused or alleged to be caused by said bridge, the case may be brought in the circuit court of the United States of the district of the State of Missouri, in whose jurisdiction and portion of said obstruction or bridge may be located. All changes in said bridge required at any time by the Secretary of War shall be made at the expense of the persons or corporation owning or controlling said bridge</p>
Changes, etc.	
Litigation.	
Lawful structure and post-route.	<p>SEC. 4. That the said bridge and accessory works, when built and constructed under this act, and according to the terms and limitations thereof shall be lawful structures; and said bridge shall be recognized and known as a post-route, upon which also no higher charge shall be made for the transmission over the same of the mails, the troops, and the munitions of war of the United States than the rate per mile paid for</p>

the transportation over the railroads or public highways leading to said bridge; and said bridge shall enjoy the rights and privileges of other post-routes in the United States.

SEC. 5. That the United States shall have the right of way for such postal and telegraph lines across said bridge as the Government may construct or control, and all telegraph and telephone companies shall have equal privileges as to said bridge. Postal tele-graph.

SEC. 6. That Congress shall have power at any time to alter, amend, or repeal this act, so as to prevent or remove all obstructions to the navigation of said river by the construction of said bridge and its accessory works; and all alterations of said bridge shall be made and all such obstructions shall be removed at the expense of the owners of or persons controlling such bridge: *Provided further*, That nothing in this act shall be so construed as to repeal or modify any of the provisions of law now existing in reference to the protection of the navigation of rivers, or to exempt this bridge from the operation of the same, Amendment, etc.

SEC. 7. That this act shall be void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date thereof. Proviso.

Approved, March 2, 1889. Existing laws.

CHAP. 407.—An act to authorize the construction of a railroad, wagon, and foot-passenger bridge across the Mississippi River at or near Lyons, Iowa. Commencement and completion.

March 2, 1889.
Vol. 25, p. 601.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Lyons and Fulton Bridge Company a corporation organized and existing under and by virtue of the laws of the State of Iowa, its successors and assigns, be and they are hereby, authorized to construct and maintain a railroad, wagon, and foot-passenger bridge across the Mississippi River at a point at or near the city of Lyons, Iowa, under the limitations and conditions hereinafter provided, and to lay on or over said bridge a tract or tracts for the more perfect connection of any railroad or railroads that are or may be constructed to said river, on either or both sides thereof, at or opposite said point. That said bridge shall not interfere with the free navigation of said river; and in case of any litigation arising from any obstruction or alleged obstruction to the free navigation of said river, the cause may be tried before the circuit court of the United States in and for any district in which any portion of said bridge or obstruction is located. Said bridge shall be constructed to provide for the safe and convenient passage of railroad trains, wagons and vehicles of all kinds, animals, and foot-passengers, for such reasonable rates of toll as may be fixed from time to time subject to approval and change by the Secretary of War. Lyons and Fulton Bridge Company may bridge Mississippi River at Lyons. Railway, wagon, and foot bridge.

SEC. 2. That any bridge built under the provisions of this act may at the option of the company building the same, be built as a ponton draw-bridge or with unbroken and continuous spans: *Provided*, That if the said bridge shall be made with unbroken and continuous spans, it shall give clear head-room of not less, in any case, than fifty-five and one-half feet above extreme high-water mark, as understood at the point of location, nor shall the spans of said bridge give a clear width of water-way of less than three hundred and fifty feet, and the piers of said bridge shall be parallel with the current of said river, and the main span shall be over the main channel of the river and give a clear width of water-way of not less than three hundred and fifty feet: *And provided further*, That if any bridge built under the provisions of this act shall be constructed as a draw-bridge, the same shall be constructed as a pivot draw-bridge, with a draw over the main channel of the river at an accessible and navigable point and with spans giving a clear width of water-way of not less than two hundred feet on each side of the central or pivot pier of the draw, and the next adjoining span or spans to the draw shall give a clear width of water-way of not less than three hundred and fifty feet: *Provided*, That if the pivot pier of said bridge shall be constructed within less than four hundred and ten feet of the west shore of said river the span constructed west of said pivot pier may be less than three hundred and fifty feet, and every part of the superstructure of said low bridge shall give a clear head-room of not less than ten feet Unobstructed navigation. Litigation.

Toll.

Construction.

Proviso.
Spans.

Draw.

Pivot pier, etc.

	above extreme high-water mark; and the piers of said bridge shall be erected: <i>And provided, also</i> , That said draw shall be opened promptly upon reasonable signal for the passage of boats: <i>And provided further</i> , That if any bridge built under the provisions of this act shall be constructed as a ponton bridge, it shall be built subject, except as herein modified, to all the terms, requirements, and limitations contained in the act entitled "An act to legalize and establish a ponton railway bridge across the Mississippi River at Prairie du Chien, and to authorize the construction of a similar bridge at or near Clinton, Iowa," approved June sixth, eighteen hundred and seventy-four, so far as they may be applicable thereto: <i>And provided, also</i> , That it shall be constructed with one suitable ponton draw of not less than five hundred feet in width, located over the main channel of the river, which shall be opened promptly upon reasonable signal for the passage of boats and as herein provided for a draw-bridge.
Opening draw.	
Ponton bridge.	
Vol. 18, p. 62.	
Draw.	
Lawful structure and post-route.	SEC. 3. That any bridge constructed under this act and according to its limitations shall be a lawful structure, and shall be known as a post-route, and the same is hereby declared to be a post-route, upon which also no higher charge shall be made for the transmission over the same of the mails, the troops, and the munitions of war of the United States, than the rate per mile paid for their transportation over the railroads and public highways leading to said bridge; and equal privileges in the use of said bridge shall be granted all railroad, telephone and telegraph companies, and the United States shall have the right of way across said bridge and its approaches for postal-telegraph purposes.
Postal telegraph.	
Use by other companies.	SEC. 4. That all railroad and other companies desiring to use said bridge shall have and be entitled to equal rights and privileges in the passage of the same, and in the use of the machinery and fixtures thereof, and of all the approaches thereto, under and upon such terms and conditions as shall be prescribed by the Secretary of War, upon hearing the allegations and proofs of the parties, in case they shall not agree.
Terms.	
Secretary of War to approve plans, etc.	SEC. 5. That the structure herein authorized shall be built and located under and subject to such regulations for the security of the navigation of said river as the Secretary of War shall prescribe; and to secure that object the said company or corporation shall submit to the Secretary of War, for his examination and approval, a design and drawing of the bridge and a map of the location, giving for the space of one mile above and one mile below the proposed location, the topography of the banks of the river, the shore-line at high and low water, the direction and strength of the current at all stages, and the soundings, accurately showing the bed of the stream, the location of any bridge or bridges, and shall furnish such other information as shall be required for a full and satisfactory understanding of the subject; and until the said plan and location of the bridge are decided by the Secretary of War to be such as will not materially or unnecessarily affect the interests of navigation, the bridge shall not be commenced or built; and should any change be made in the plan of said bridge during the progress of construction, such change shall be subject to the approval of the Secretary of War; and the said bridge shall be constructed with such aids to the passage of said bridge, in the form of booms, dikes, piers, or other suitable and proper structures for confining the flow of water to a permanent and easily navigated channel, for a distance of not less than one mile above the bridge location, and for the guiding of rafts, steam-boats, and other watercraft safely through the draw and raft spans, as the Secretary of War shall from time to time prescribe and order to be constructed and maintained at the expense of the company owning said bridge; and the said structure shall be at all times so kept and managed as to offer reasonable and proper means for the passage of vessels through or under said structure; and for the safety of vessels passing at night there shall be displayed on said bridge, from the hours of sunset to sunrise, such lights as may be prescribed by the Light House Board; and the said structure shall be changed or removed at the cost and expense of the owners thereof from time to time as Congress or the Secretary of War may direct, so as to preserve the free and convenient navigation of said river; and the authority to erect and continue said bridge shall be subject to revocation and modification by law, when the public
Aids to navigation.	
Lights.	
Changes.	

good shall, in the judgment of Congress or the Secretary of War so require, without any expense or charge to the United States.

Sec. 6. That if actual construction of the bridge herein authorized shall not be commenced within two years from the passage of this act, and be completed in four years from the same date, the rights and privileges hereby granted shall cease and be determined.

Sec. 7. That the right to alter, amend, or repeal this act is hereby expressly reserved.

Approved, March 2, 1839.

Amendment, etc.

CHAP. 468.—An act to amend an act entitled "An act to authorize the construction of a bridge over the Missouri River at the most accessible point between the mouth of the Femme Osage Creek and a point two miles above the city of Saint Charles, in the County of Saint Charles, in the State of Missouri." March 2, 1839. Vol. 25, p. 303.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That an act entitled "An act to authorize the construction of a bridge over the Missouri River at the most accessible point between the mouth of the Femme Osage Creek and a point two miles above the city of Saint Charles, in the county of Saint Charles, in the State of Missouri," approved May seventeenth, eighteen hundred and eighty-six, be, and the same is hereby, amended as follows, namely:

Strike out the first section of said act and insert in lieu thereof the following:

"That the Cleveland, Saint Louis and Kansas City Railway Company, a corporation organized under the laws of the State of Missouri (and being the successor and assignee of the Saint Louis and Kansas City Short-Line Railway Company), and its assigns and successors, is hereby authorized to construct and maintain a bridge across the Missouri River at such point as may be hereafter selected by said corporation between the city of Saint Charles and the mouth of the Missouri River, in the county of Saint Charles, in the State of Missouri, as shall best promote the public convenience and welfare and the necessities of business and commerce, and also to construct accessory works to secure the best practicable channel-way for navigation and to confine the flow of the water to a permanent channel at such point, and to lay on and over said bridge one or more railroad tracks for the more perfect connection of any railroads that are or shall be constructed to said river at or opposite said point."

Strike out section three of said act and insert in lieu thereof the following:

"Sec. 3. That if said bridge shall be made with unbroken and continuous spans, the spans thereof shall not be less than three hundred feet in length in the clear, and the main span shall be over the main channel of the river. The lowest part of the superstructure of said bridge shall be at least fifty feet above high-water mark, as understood at the point of location, and the bridge shall be at right angles to and its piers parallel with the current of the river: *Provided*, That if the same shall be constructed as a draw-bridge, the draw or pivot shall be over the main channel of the river at an accessible point, and the spans shall not be less than one hundred and sixty feet in length in the clear, and the piers of said bridge shall be parallel with and the bridge itself at right angles to the current of the river, and the spans shall not be less than ten feet above extreme high-water mark, as understood at the point of location to the lowest part of the superstructure of said bridge: *Provided, also*, That said draw shall be opened promptly upon reasonable signal for the passage of boats; and said company or corporation shall maintain, at its own expense, from sunset to sunrise, such lights or other signals on said bridge as the Light-House Board shall prescribe. No bridge shall be erected or maintained under the authority of this act which shall at any time substantially or materially obstruct the free navigation of said river; and if any bridge erected under such authority shall, in the opinion of the Secretary of War, obstruct such navigation he is hereby authorized to cause such change or alteration of said bridge to be made as will effectually obviate such obstruction; and all such alterations shall be made and all such obstructions be removed at the expense of the owner or owners

Bridge over Missouri River at Saint Charles, Mo. Location and corporation changed. Vol. 24, p. 60.

Railway bridge.

Construction. Spans.

Provisos. Draw.

Opening draw. Lights, etc.

Unobstructed navigation.

Litigation. of said bridge; and in case of any litigation arising from any obstruction or alleged obstruction to the free navigation of said river caused or alleged to be caused by said bridge, the case may be brought in the district court of the United States of the State of Missouri, in which any portion of said obstruction or bridge may be located: *Provided further*, That nothing in this act shall be so construed as to repeal or modify any of the provisions of law now existing in reference to the protection of the navigation of the river, or to exempt this bridge from the operation of the same.

Approved, March 2, 1889.

March 2, 1889.
Vol. 25, p. 904.

CHAP. 409.—An act to authorize the construction of bridges over Green and Barren Rivers, in the State of Kentucky, by the Henderson State Line Railroad Company.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Henderson State Line Railroad Company, organized under an act of the general assembly of the Commonwealth of Kentucky, be, and is hereby, authorized to construct and maintain one or more bridges, and approaches thereto, over Green River and Barren River, in the State of Kentucky, at such points as said company may deem suitable for the passage of its said road over said rivers. Said bridges shall be constructed to provide for the passage of railway trains, and, at the option of the corporation by which they may be built, may be used for the passage of wagons and vehicles of all kinds, for the transit of animals, and for foot passengers.

Henderson State Line Railroad Company may bridge Green and Barren Rivers, Ky.

Railway, wagon, and foot bridges.

Lawful structures and post-routes.

Postal telegraph.

Use by other companies.

Compensation.

Decision by Secretary of War.

Secretary of War to approve plans, etc.

Amendment.

Commencement and completion.

SEC. 2. That any bridges built under this act and subject to its limitations shall be lawful structures and shall be recognized and known as post-routes, and they shall enjoy the same rights and privileges as other post-roads in the United States. Equal privileges in the use of said bridge shall be granted to all telegraph and telephone companies and the United States shall have the right of way across said bridge and its approaches for postal telegraph purposes.

SEC. 3. That all railroad companies desiring the use of said bridges shall have and be entitled to equal rights and privileges relative to the passage of railway trains over the same, and over the approaches thereto, upon the payment of a reasonable compensation for such use; and in case the owner or owners of said bridges and the several railroad companies, or any of them desiring such use, shall fail to agree upon the sum or sums to be paid, and upon rules and conditions to which each shall conform in using said bridges, all matters at issue between them shall be decided by the Secretary of War upon a hearing of the allegations and proofs of the parties.

SEC. 4. That any bridges authorized to be constructed under this act shall be built and located under and subject to such regulations for the security of the navigation of said river as the Secretary of War shall prescribe, and to secure that object the said company or corporation shall submit to the Secretary of War, for his examination and approval, a design and drawing of the bridges and a map of the location thereof, and until the said plan and location of the bridges are approved by the Secretary of War the bridges shall not be commenced or built; and should any changes be made in the plan of said bridges during the progress of construction such changes shall be subject to the approval of the Secretary of War, and all changes in said bridges required by the Secretary of War at any time or their entire removal shall be at the expense of the corporations or persons owning or operating said bridges.

SEC. 5. That the right to alter, amend, or repeal this act is hereby expressly reserved.

SEC. 6. That this act shall be null and void if actual construction of the bridges herein authorized are not commenced within one year and completed within three years from the date thereof.

Approved, March 2, 1889.

March 2, 1889.
Vol. 25, pp. 905,
914, 916.

CHAP. 410.—An act making appropriations to supply deficiencies in the appropriations for the fiscal year ending June thirtieth, eighteen hundred and eighty-nine, and for prior years and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated, out of any money in the Treas-

Deficiencies appropriations.

try not otherwise appropriated, to supply deficiencies in the appropriations for the fiscal year eighteen hundred and eighty-nine; and for prior years, and for other objects hereinafter stated, namely:

WAR DEPARTMENT.

War Department.

WATER SUPPLY, DISTRICT OF COLUMBIA: To enable the Secretary of War to cause to be constructed and put in operation a forty-eight inch cast-iron main from the present distributing reservoir above Georgetown, easterly to Rock Creek at M street, and thence along M street to New Hampshire avenue; thence northeasterly along New Hampshire avenue to R street north; thence along R street, to connect with the present forty-eight inch main from the new reservoir at R and Fourth streets, and to make the necessary connections and to provide the necessary apparatus for thereby specially supplying the present deficiencies of water at the higher levels of the city, and in general to increase the water supply, five hundred and seventy-five thousand dollars. The said work shall be done under the direction of the Chief of Engineers, in the shortest practicable time. If it shall appear to the Secretary of War, on the report of the Chief of Engineers, that for any cause the work can not be carried on, or material therefor cannot be obtained as rapidly as is necessary for the best and most vigorous prosecution of it, he is authorized to provide material by purchase in open market or by special contract for the fabrication thereof, and to carry on the work by days' work or otherwise, as it may seem to him expedient. This appropriation shall be charged against the revenues applicable to the expenses of carrying on the government of the District of Columbia, so that one-half will be paid from the Treasury of the United States and the other half from moneys derived from taxation in the District.

Water supply,
D. C.
New 48-inch
water main.

May be by special contract etc.

To reimburse and pay the sum of twelve thousand four hundred and twelve dollars to each of the following named companies, to-wit: The Chicago and Atchison Bridge Company, the Kansas City, Saint Joseph and Council Bluffs Railroad Company, the Hannibal and Saint Joseph Railroad Company, the Chicago, Rock Island and Pacific Railroad Company, and the Atchison, Topeka and Santa Fe Railroad Company, for moneys expended by said companies in the construction of works at Winthrop, Missouri, for the protection of the shores of the Missouri River and necessary to preserve navigation at said point; in all, sixty-two thousand and sixty dollars.

Missouri
River.
Reimbursement for protecting shores at Winthrop, Mo.

TELEGRAPH TO CONNECT THE CAPITOL WITH THE DEPARTMENTS AND GOVERNMENT PRINTING OFFICE: To pay the Standard Underground Cable Company, of Pittsburgh, Pennsylvania, in full, for underground electric cables laid in the city of Washington, District of Columbia, in October, eighteen hundred and eighty-three, connecting the Capitol, Executive Mansion, State, War, and Navy Departments, and other Government offices, and the Smithsonian Institution, under terms of permit of War Department, dated October third, eighteen hundred and eighty-three, approved October ninth, eighteen hundred and eighty-three, by H. G. Wright, Chief of Engineers, or other authority, eleven thousand dollars, which said sum shall be in full payment for the purchase of said cables and for all demands or equities of said Standard Underground Cable Company against the Government for underground electric cables laid as aforesaid in the District of Columbia.

Telegraph, D. C.
Standard Underground Cable Company.
Payment for cable connecting Capitol, Departments, and Government Printing Office.

Approved, March 2, 1889.

CHAP. 411.—An act making appropriations for sundry civil expenses of the Government for the fiscal year ending June thirtieth, eighteen hundred and ninety, and for other purposes.

March 2, 1889.
Vol. 25, pp. 939,
964, 966, 970, 971.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated for the objects hereinafter expressed.

Sundry civil expenses appropriated.

pressed for the fiscal year ending June thirtieth, eighteen hundred and ninety, namely:

Buildings and
grounds, Wash-
ington, D. C.
Improvement
and care.

BUILDINGS AND GROUNDS IN AND AROUND WASHINGTON.

For the improvement and care of public grounds as follows:

For improvement of grounds north of Executive Mansion, two thousand five hundred dollars.

For improvement and maintenance of grounds south of the Executive Mansion, four thousand dollars.

For ordinary care of green-houses and nursery, two thousand dollars.

For ordinary care of Lafayette Square, one thousand dollars.

For ordinary care of Franklin Square, one thousand dollars.

For care and improvement of Monument Grounds, five thousand dollars.

For continuing improvement of reservation numbered seventeen and site of old canal northwest of same, ten thousand dollars: *Provided*, That no part thereof shall be expended upon other than property belonging to the United States.

Proviso.

For construction and repair of post-and-chain fences, and constructing stone coping around reservations, one thousand five hundred dollars.

For manure, and hauling the same, five thousand dollars.

For painting watchmen's lodges, iron fences, vases, lamps, and lamp-posts, seven hundred and fifty dollars.

For purchase and repair of seats, one thousand dollars.

For purchase and repair of tools, two thousand dollars.

For trees, tree and plant stakes, labels, lime, whitewashing, and stock for nursery, three thousand dollars.

For removing snow and ice, one thousand two hundred dollars.

For flower-pots, twine, baskets, wire, splints, moss, and lycopodium, one thousand dollars.

For care, construction, and repair of fountains, one thousand five hundred dollars.

For abating nuisances, five hundred dollars.

For improvement, care, and maintenance of various reservations, twelve thousand dollars.

For improvement, maintenance, and care of Smithsonian Grounds, including construction of asphalt roads and paths, eight thousand dollars.

For improvement, care, and maintenance of Judiciary Square, including grounds around the Pension Building and asphalt roads and walks leading to Pension Building, five thousand dollars.

Concrete pavements.

That under appropriations herein contained no contract shall be made for making or repairing concrete or asphalt pavements in Washington City at a higher price than two dollars per square yard for a quality equal to the best laid in the District of Columbia prior to July first, eighteen hundred and eighty-six, and with same depth of base.

EXECUTIVE MANSION.

Executive Mansion.

For care, repair, repainting, and refurnishing the Executive Mansion, sixteen thousand dollars, to be expended by contract or otherwise, as the President may determine.

Repairs, fuel, etc.

For fuel for the Executive Mansion, greenhouses, and stables, three thousand dollars.

For care and necessary repair of greenhouses, five thousand dollars.

Lighting Executive Mansion and public grounds.

LIGHTING THE EXECUTIVE MANSION AND PUBLIC GROUNDS: For gas, pay of lamp-lighters, gas-fitters, and laborers; purchase, erection, and repair of lamps and lamp-posts; purchase of matches, and for repairs of all kinds; fuel and lights for office, office stables, watchmen's lodges, and for the greenhouses at the nursery, fourteen thousand dollars: *Provided*, That for each six-foot burner not connected with a meter in the lamps on the public grounds no more than twenty dollars shall be paid per lamp for gas, including lighting, cleaning, and keeping in repair the lamps, under any expenditure provided for in this act; and said lamps shall burn not less than two thousand six hundred hours per annum; and authority is hereby given to substitute other illuminating material for the same or less price, and to use so

Proviso.
Maximum
price per lamp.

much of the sum hereby appropriated as may be necessary for that purpose.

For erecting seven iron posts, each twenty-five feet high, and connecting them with underground wires for electric lights, one thousand dollars. Electric light-
ing.

For electric lights for three hundred and sixty-five nights, from seven posts, at forty cents per night, one thousand and twenty-two dollars.

REPAIR OF WATER PIPES: For repairing and extending water-pipes, purchase of apparatus to clean them, purchase of hose, and cleaning the springs and repairing and renewing the pipes of the same that supply the Capitol, the Executive Mansion, and the building for the State, War, and Navy Departments, two thousand five hundred dollars. Water-pipes,
etc.

TELEGRAPH TO CONNECT THE CAPITOL WITH THE DEPARTMENTS AND GOVERNMENT PRINTING OFFICE: For care and repair of existing lines, one thousand two hundred and fifty dollars. Government
telegraph.

WASHINGTON MONUMENT: For the care and maintenance of the Washington Monument and the operation of the elevator and machinery connected therewith, namely: For one custodian, at one hundred dollars per month; one steam engineer at eighty dollars per month; one assistant steam engineer, at sixty dollars per month; one fireman, at fifty dollars per month; one assistant fireman, at forty-five dollars per month; one conductor of elevator car, at seventy-five dollars per month; one attendant on floor, at forty-five dollars per month; one attendant at top, at forty-five dollars per month; three night and day watchmen, at sixty dollars each per month; in all, eight thousand one hundred and sixty dollars. Washington
Monument.
Care and main-
tenance.

For fuel, lights, oil, waste, packing, tools, matches, paints, brushes, brooms lanterns, rope, nails, screws, lead, electric lights, heating apparatus, oil stoves for elevator car and upper and lower floor, repairs to engines, boilers, dynamos, elevator, and repairs of all kinds connected with the monument and machinery, and purchase of all necessary articles for maintaining the monument, machinery, elevator, and electric light plant in good order, two thousand three hundred and forty dollars to be expended under the direction of the Secretary of War. Expenses.

BUILDING FOR THE LIBRARY OF CONGRESS.

For the building for the Library of Congress, as authorized by the sundry civil appropriation act approved October second, eighteen hundred and eighty-eight, except as herein modified, and for each and every purpose connected therewith, five hundred thousand dollars. And said building shall be constructed in accordance with the plans marked "D," submitted by the Chief of Engineers with his annual report to Congress, being Miscellaneous Document Number Twelve, Fiftieth Congress, second session, and at a total cost therefor not exceeding five million five hundred thousand dollars exclusive of appropriations heretofore made, and no changes or modifications shall be made that will increase the cost above the limitation herein prescribed: *Provided*, That contracts may be entered into for all the stone required for the exterior walls of said building to be paid for as appropriations may from time to time be made by law. Library Build-
ing.
Expenses of
building.
Laws, 1st sess.
50th Cong., p. 523.
Plans adopted.
Limit of cost.
Proviso.
Stone con-
tracts.

PROTECTION AND IMPROVEMENT OF THE YELLOWSTONE NATIONAL PARK: For the construction and improvement of suitable roads and bridges within the Park, under the supervision and direction of an engineer officer detailed by the Secretary of War for that purpose, fifty thousand dollars. Yellowstone
Park.

MONUMENTS OR TABLETS AT GETTYSBURGH: That the appropriation of fifteen thousand dollars, made by the act approved March third, eighteen hundred and eighty seven, for the erection of monuments or memorial tablets for the proper marking of the position of each of the commands of the regular Army engaged at Gettysburgh, be, and the same is hereby, made available for the purchase of land upon which to erect the monuments and tablets, for the purchase of land for drive-ways to connect the monuments, and for the construction and repair of the same. Monuments,
etc.
Gettysburgh.
Vol. 24, p. 535.
Purchase of
land.

Miscellaneous.

MISCELLANEOUS OBJECTS.

War maps.	WAR MAPS: For reprinting war maps, five thousand dollars.
Survey, lakes.	SURVEY OF NORTHERN AND NORTHWESTERN LAKES: For printing and issuing charts for use of navigators, and electrotyping plates for chart-printing, two thousand dollars.
	For surveys, additions to and correcting engraved plates, five thousand dollars.
Transporting reports, etc.	TRANSPORTATION OF REPORTS AND MAPS TO FOREIGN COUNTRIES: For the transportation of reports and maps to foreign countries, through the Smithsonian Institution, one hundred dollars.
	* * *
New York Harbor.	HARBOR OF NEW YORK: For expenses in preventing obstructive and injurious deposits in the harbor and adjacent waters of New York City, including sixty thousand dollars for the purchase or construction of a vessel, ninety-four thousand and seventy dollars.
Preventing obstructions, etc.	For the construction of an iron bridge over Mill Creek, between the military reservation of Fortress Monroe and Elizabeth City County, Virginia, twenty thousand dollars, to be expended under the direction of the Secretary of War.
Fortress Monroe.	SURVEYS FOR DEEP-WATER HARBOR, GULF OF MEXICO: The Secretary of War is hereby authorized and directed to appoint a board of three engineer officers of the United States Army, whose duty it shall be to make a careful and critical examination of the northwest coast of the Gulf of Mexico, west of ninety-three degrees and thirty minutes west longitude, and report as to the most eligible point or points for a deep harbor, to be of ample depth, width, and capacity to accommodate the largest ocean-going vessels and the commercial and naval necessities of the country, which can be secured and maintained in the shortest time and at the least cost: <i>Provided</i> , That this action shall not be construed to imply a cessation of work on other points on the Gulf coast, the improvement of which is deemed necessary for commercial or naval purposes. And the board of engineers shall report the result of its investigations to the Secretary of War as soon as practicable.
Bridge across Mill Creek.	
Gulf of Mexico.	
Survey for a deep-water harbor.	
Provide.	
Other work not to cease.	
Expenses.	To pay the expenses of said board, two thousand dollars, or so much thereof as may be necessary.

* * *

Approved, March 2, 1889.

March 2, 1889. CHAP. 417.—An act granting right of way and other privileges to the Hampton and Old Point Railway Company.

Hampton and Old Point Railway Company granted right of way through Government lands, Fortress Monroe, Va.	<i>Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled</i> , That the Hampton and Old Point Railway Company, a corporation chartered by the general assembly of Virginia by act approved February twenty-fourth, eighteen hundred and eighty-eight, and thereby empowered in constructing a railroad from the town of Hampton to Old Point Comfort, to build and operate the same, by and with the consent of the Congress of the United States, over any lands heretofore ceded by the State of Virginia to the United States, be, and it is hereby, authorized to construct and operate a street railway over and through the land ceded by Virginia to the United States at or near Fortress Monroe, from Old Point Comfort to the National Home for Disabled Volunteer Soldiers, and to Hampton Institute, Virginia, and right of way for said purpose is hereby granted to the said corporation, subject to the following provisions:
Location.	First. Said railroad shall cross Mill Creek upon a bridge distinct from the existing bridge owned by the United States or upon such bridge additional to and united to the existing bridge as may be approved by the Secretary of War. It shall follow the water line of Hampton Roads along the western side of the land ceded to the United States by Virginia, terminating at some point north of the Quartermaster's Pier, or near to and on the west of the highway nearly opposite the main entrance to Fortress Monroe.
Bridge.	Second. So much of said road as may be upon said lands ceded as aforesaid shall be constructed upon such plans and dimensions as may be approved by the Secretary of War.
Approval of Secretary of War.	

Third. The manner and times of running cars of said road shall be subject to such special orders or general regulations as the Secretary of War may deem necessary to the good order and the military uses of the military post and ceded lands. Rules for running cars, etc.

Fourth. Charges for the transportation of any inmate, officer, or employee of the Soldiers' Home or Hampton Institute, or any enlisted man or civilian employee of the military force at Fortress Monroe over the entire line of said road shall not exceed ten cents. Charges.

Fifth. The privileges hereby granted may at any time be rescinded or suspended by order of the Secretary of War, and said corporation shall at any time, when so ordered by the Secretary of War, remove its rails and all other fixtures and appurtenances at its own expense and cost and without any claim of any kind whatever for any loss, damage, or compensation of any kind from the United States. Revocable.

Sixth. The grants and privileges mentioned in this act shall be determined and become void unless the said road shall be completed and put in operation within said ceded lands within two years from the passage of this act. Commencement and completion.

SEC. 2. That this act shall be subject to alteration, amendment, or repeal at any time at the pleasure of Congress.

Amendment,
etc.

Approved, March 2, 1889.

RESOLUTION.

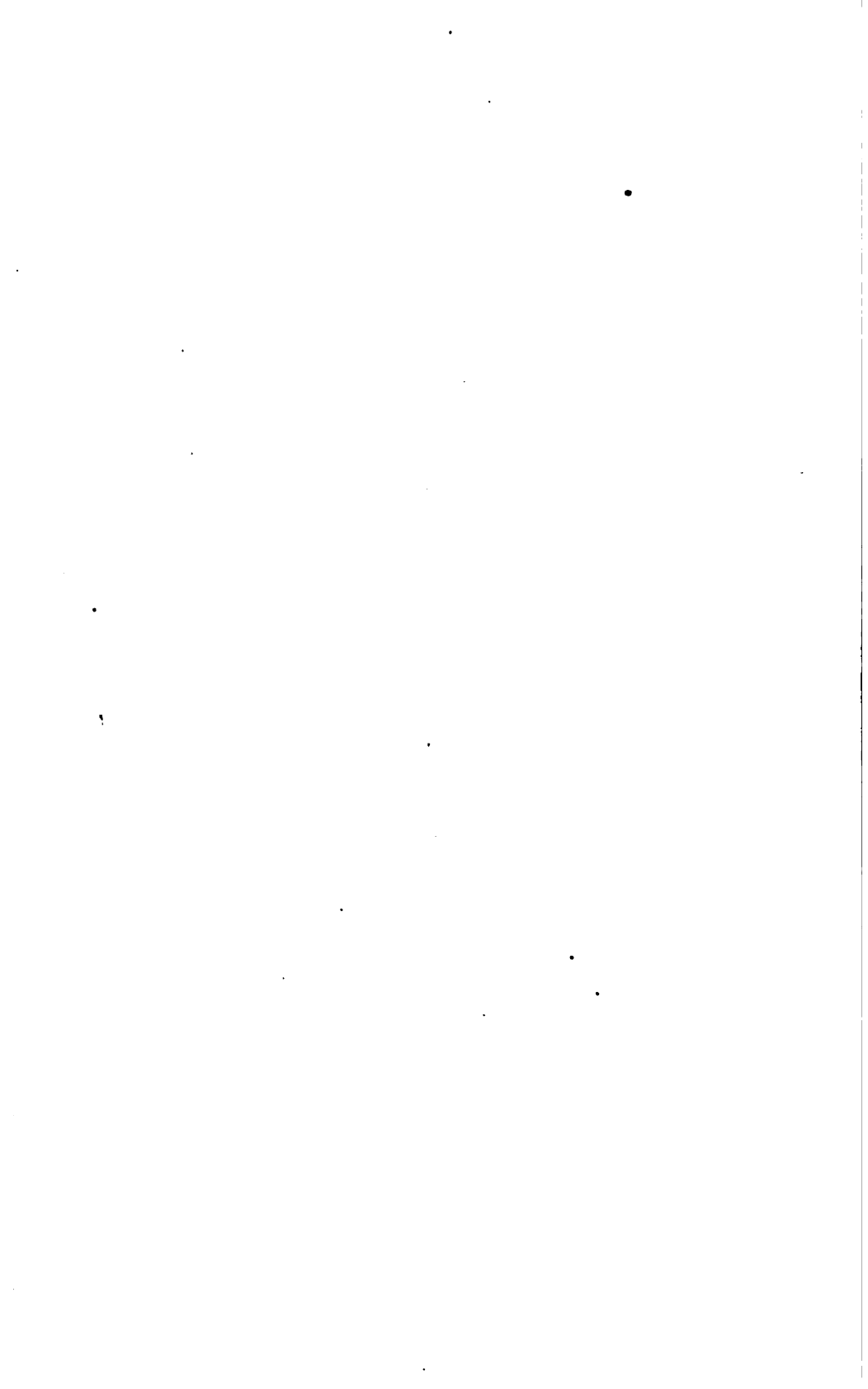
[No. 6.] Joint resolution making an appropriation for payment to the legal representatives of James B. Eads. February 14, 1889.
Vol. 25, p. 1385.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That there be, and hereby is, appropriated, out of any money in the Treasury not otherwise appropriated, the sum of five hundred thousand dollars, to enable the Secretary of War to pay to the legal representatives of James B. Eads half the sum of one million dollars retained by the United States under the act of March third, eighteen hundred and seventy-five, to be paid on the expiration of ten years' maintenance of the channel the maximum depth and width as required by said act of March third, eighteen hundred and seventy-five and subsequent acts. James B. Eads.

Payment to legal representatives.

Vol. 18, p. 465.

Approved, February 14, 1889

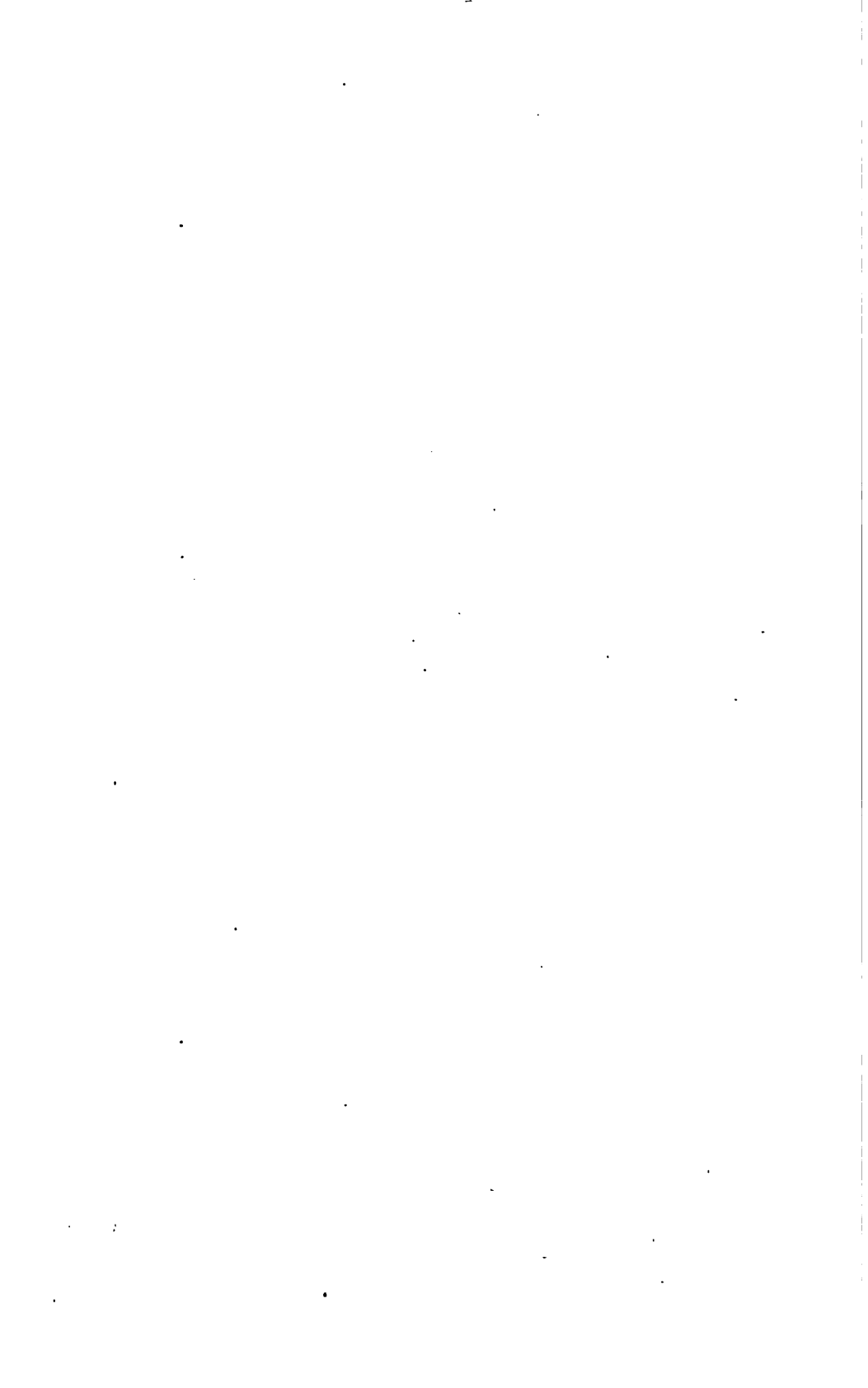


APPENDIXES

TO THE

REPORT OF THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.



APPENDIXES
TO THE
REPORT OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY.

FORTIFICATIONS, ETC.

APPENDIX No. 1.

SEA-WALL AT DAVID'S ISLAND, NEW YORK HARBOR—SEA-WALL AT GOVERNOR'S ISLAND, NEW YORK HARBOR.

REPORT OF COLONEL DAVID C. HOUSTON, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1889.

IMPROVEMENTS.

- a. Sea-wall at David's Island, New York Harbor.
 - b. Sea-wall at Governor's Island, New York Harbor.
-

ENGINEER'S OFFICE, U. S. ARMY,
New York, July 13, 1889.

GENERAL: I have the honor to transmit herewith * * * annual reports for sea-walls at Governor's and David's islands, New York Harbor.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Colonel of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

I A.

SEA-WALL AT DAVID'S ISLAND, NEW YORK HARBOR.

This island, which is occupied by the recruiting service of the Army, lies at the head of Long Island Sound and about opposite New Rochelle, N. Y. In 1883, upon recommendation of the depot surgeon, an estimate for the sea-wall was transmitted to Congress, papers concerning which were printed in House Ex. Doc. No. 205, Forty-eighth Congress, second session. This recommendation was renewed in 1884. The object stated in the first recommendation was to prevent the collection of garbage and refuse matter upon the shores; the second recommendation stated as an additional and important object the preservation of a fresh-water pond from overflow of the sea at high tide, the water of the pond being a reservoir from which the cisterns of the island were filled during dry seasons. An additional object is the reclamation of a rather important tract of land lying back of the proposed wall.

A revised estimate presented in 1886 placed the cost as follows:

1,000 linear feet of wall, at \$35 per foot	\$35,000
40,000 cubic yards earth embankment, at 30 cents per cubic yard.....	12,000
Total.....	47,000

The plan was to build the wall of masonry and to carry it to 12 feet above mean low-water level. The mean rise of tide is 7.3 feet.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1889.

From the appropriation made by Congress for sea-walls and embankments, approved September 22, 1888, allotment was made of \$35,000 for the sea-wall and \$12,000 for the earth embankment.

As the stringent regulations now being enforced in relation to the dumping of garbage in the harbor of New York and adjacent waters will prevent such garbage becoming a source of nuisance and possible ill-health, a vertical wall seemed no longer necessary, and with approval of the Chief of Engineers the design of the wall was modified to a wall of riprap, with outer slope of 1 on 2 and inner slope of 1 on 1, rising to 10 feet above low water, the whole to be capped with dimension stones 2 feet thick, making the top of the wall 6 feet wide. This plan was recommended as being more economical and equally efficient.

After duly advertising and receiving proposals, a contract dated April 13, 1889, was entered into with John Sheehan, of New Rochelle, N. Y., for constructing the wall as designed, at the rate of \$1.50 per gross ton for riprap stone delivered and properly placed, and rate of \$7 per linear foot for the capping stone. Work under this contract was begun May 4, 1889, and up to the close of the fiscal year 4,046 tons of riprap had been placed in the wall, building up 747 linear feet of it to different stages of completion. The length of the completed wall will be about 980 feet.

Proposals for the embankment behind the wall were advertised for and opened May 16, 1889, and under date of June 1, 1889, a contract was entered into with John Sheehan for furnishing and placing about 35,000 cubic yards of filling in the embankment at the rate of 40 cents per cubic yard. Work was begun June 25, and 625 yards of embankment were placed during the fiscal year.

The available funds will be sufficient to complete the work under these contracts.

Abstract of proposals for construction of sea-wall at David's Island, New York Harbor, opened March 28, 1889, by Lieut. Col. D. C. Houston, Corps of Engineers.

No.	Names of bidders.	Rate per ton for riprap (9,050 tons).	Rate per linear foot for capping stone (980 linear feet).	Amount of bid.	Remarks.
1	John T. Rowland, Jersey City, N. J.	\$1.87½	\$10.90	\$27,650.75	Greenwich or New York for riprap. Greenwich for capping or stone equally as good.
2	S. & E. S. Belden, Rocky Hill, Conn.	1.65	7.05	21,060.50	Brown stone.
3	William H. Morton, New York City.	2.10	6.60	25,473.00	Hard and durable stone.
4	John S. Howell, New York City.	2.50	10.00	32,425.00	Kind of stone not stated.
5	John Sheehan, New Rochelle, N. Y.	1.50	7.00	20,435.00	Lowest bid Greenwich granite.
6	Francis H. Smith, New York City.	1.79	7.92	23,961.10	Sandy Hill stone for capping, New York, or Connecticut River for riprap; verbal.
7	Augustine M. Newton, New York City.	1.56	10.80	24,702.00	Maine granite for capping, New York stone for riprap.

* Entered into contract April 12, 1889; in progress.

NOTE.—Amount available for contract, \$30,000.

Abstract of proposals for embankment at David's Island sea-wall, New York Harbor, opened May 16, 1889, by Lieut. Col. D. C. Houston, Corps of Engineers.

No.	Names of bidders.	Rate per cubic yard (35,000 cubic yards).	Amount of bid.	Remarks.
1	Ciancimino's Towing and Transportation Company, New York City.	Cents. 42½	\$14,875	
2	Francis H. Smith, New York City.....	54	18,000	
3	John Sheehan, New Rochelle, N. Y.....	40	14,000	Lowest bid.

* Entered into contract June 1, 1889; in progress.

NOTE.—Amount available for contract work, \$10,000.

I B.

SEA-WALL AT GOVERNOR'S ISLAND, NEW YORK HARBOR.

The shores of this island were frequently covered with offal and garbage, which, drifting up at high water and decaying in the sun as the tide fell, were (in summer) a source of constant danger to the health of the garrison. In 1865 a project was adopted providing for enclosing the entire island by a masonry sea-wall, to be built at or near low-water line, in order to prevent the lodging of such refuse matter.

Under an allotment made in 1865, 700 linear feet of masonry wall were built on the southwest side of this island in 1866; and under other smaller allotments, 399 linear feet were built, making a total of 1,099 feet.

This was subsequently extended as a temporary dry wall nearly along

high-water mark to Castle William, covering the entire southwest side of the island. By the act approved August 7, 1882, \$39,000 were appropriated "for completing a sea-wall already commenced on the southwest side of Governor's Island, New York Harbor, and constructing a sea-wall on its southeastern portion."

Under this appropriation and one of \$15,000 made in the sundry civil bill, approved March 3, 1883, the wall was extended 206 feet along the south side of the island and 1,502½ feet along the east side to the coal wharves. From this point the island is inclosed by wharf-fronts and by the "ordnance wall," extending around the northeast side and along the northwest side to within about 1,075 feet from the engineer wharf and the Castle Williams wall.

In 1884, an allotment of \$500 was made for completing the filling and grading behind the east wall, left unfinished on account of exhaustion of funds.

Under the appropriation of September 22, 1888, \$50,000 was made available for this work, and after duly advertising proposals were opened March 11, 1889, and a contract dated April 4, 1889, was entered into with Francis H. Smith, of New York City, to construct a masonry wall on the north shore of the island from the existing ordnance wall to the Castle Williams wall, a distance of about 1,075 feet, at a rate of \$14.70 per cubic yard of concrete foundation, \$15 per cubic yard of wall, and 25 cents per pound for dowels, if required.

The wall is to consist of a concrete foundation to a height of four-tenths of a foot above mean low water, the depth of the foundation, being determined by the character of the bottom, varies from 1 to 8 feet. Above the foundation is a wall of cut stone, backed with concrete, 10 feet high.

Preliminary work, consisting of the erection of derricks, tool-house, sleeping quarters for men, etc., was commenced by the contractor April 2, 1887.

Substantial sheet-piling of 3-inch spruce plank, supported by round piles and stringers, was driven for a distance of 137 feet on the rear line of the wall, and 141 feet in front of the wall, just east of the engineer wharf. A clam-shell dredge, and a 10-inch wrecking pump, were employed in excavating between this sheet-piling.

A number of large boulders were removed from the line of the wall by blasting.

The work of construction of the sea-wall was begun the 1st of May at the end nearest Castle Williams and is still in progress.

To June 30, 338 cubic yards of concrete foundation were put in, and 277 cubic yards of cut-stone wall were laid. The foundation was completed a distance of 261 feet from the Castle Williams wall, and the cut-stone wall for a distance of 180 feet, some of the lower courses being laid for a further distance of 50 feet.

A Reihle cement-testing machine was purchased, and numerous tests have been made of the cement used in construction of the sea-wall and also of cement for work on the mining casemate at Fort Wadsworth. Three hundred and fifty-eight briquettes were broken in testing nine different brands of cement.

Bids for placing filling back of the sea-wall were opened May 16, 1889, and the contract awarded to Michael Donnelly, of Brooklyn, N. Y. No work has as yet been done under this contract, but the contractor is about to commence work.

In order to complete the project adopted in 1865 for inclosing the entire island, there is yet to be built, in addition to the work provided for under existing contracts, about 1,500 feet of sea-wall south and east

from Castle Williams wall, near low-water line, to connect with the wall built in 1866. This part of the island is now partially protected by a dry-stone wall near high-water line which, however, does not keep refuse from lodging on the beach, nor prevent the caving of the bank behind it; it should be replaced by a masonry wall, as designed.

The cost of this sea-wall is estimated at \$50,000, which sum could be profitably expended in its construction during the next fiscal year.

Abstract of proposals for construction of sea-wall on Governor's Island, New York Harbor, opened March 11, 1889, by Lieut. Col. D. C. Houston, Corps of Engineers.

No.	Names of bidders.	Foundation— rate per cubic yard (375 cubic yards).	Wall— rate per cubic yard (1,450 cubic yards).	Iron cramps and dowels (rate per pound).	Amount of bid.	Remarks.
1	Francis H. Smith, New York City.	\$14.70	\$15.00	\$0.25	\$27,262.50	Lowest bid. Bluedolomite.
2	Wm. H. Moltrop & Co., New London, Conn.	8.00	22.00	.35	34,900.00	Granite.
3	John T. Rowland, Jersey City, N. J.	8.87	22.97	.75	36,632.75	Kind of stone not stated.
4	John Donaldson, Brooklyn, N. Y.	6.47½	22.80	.05	34,328.18	Verbal. Granite.
5	John Sheehan, New Rochelle, N. Y.	10.00	26.00	.30	41,450.00	Greenwich granite.
6	D. Henry Cram, Boston, Mass.	8.90	20.90	.19	33,806.75	Maine granite. No guarantors.
7	Herbert Steward, New York City.	9.00	19.08	.25	31,041.00	Kind of stone not stated.
8	Cornell Bradley and Andrew McMillan, New York City.	16.00	25.50	.04½	42,975.00	Maine granite.
9	Michael Giblin, New York City.	8.00	25.00	.05	39,250.00	Granite.
10	Clancharino's Towing and Transportation Company, New York City.	10.20	23.92	.30	38,509.00	Granite. No guarantors.

* Entered into contract April 4, 1889; in progress.

NOTE.—Amount available for contract work, \$40,000.

Abstract of proposals for embankment at Governor's Island sea-wall, New York Harbor, opened May 16, 1889, by Lieut. Col. D. C. Houston, Corps of Engineers.

No.	Names of bidders.	Rate per cubic yard (24,000 cubic yards).	Amount of bid.	Remarks.
1	Francis H. Smith, New York City	<i>Cents.</i> 27.40	\$6,576	
2	Clancharino's Towing and Transportation Company, New York City.	29.50	7,080	
3	Michael Donnelly, Brooklyn, N. Y.	22.50	5,400	Lowest bid.

* Entered into contract May 31, 1889; contract not yet begun.

NOTE.—Amount available for contract work, about \$10,000.

APPENDIX No. 2.

WHARF AT FORT MONROE, VIRGINIA—BRIDGE OVER MILL CREEK AT FORT MONROE, VIRGINIA.

REPORT OF LIEUTENANT-COLONEL PETER C. HAINS, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR FISCAL YEAR ENDING JUNE 30, 1889.

IMPROVEMENTS.

- a. Wharf at Fort Monroe, Virginia.
 - b. Bridge over Mill Creek at Fort Monroe, Virginia.
-

UNITED STATES ENGINEER OFFICE,
Washington D. C., July 9, 1889.

GENERAL: I have the honor to transmit herewith my annual report pertaining to works under my charge for the fiscal year ending June 30, 1889.

Very respectfully, your obedient servant,

PETER C. HAINS,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

2 A.

WHARF AT FORT MONROE, VIRGINIA.

At the close of the last fiscal year, June 30, 1888, work was in progress under the contract of the Groton Bridge and Manufacturing Company, for the construction of an iron wharf at Fort Monroe, Va., the operations of the contractors prior to that date having been confined to the casting of iron piles, and to other similar work at their shops in Groton, N. Y.

The Light-House Wharf was repaired and enlarged by the Quartermaster Department, and after these repairs were completed in July, 1888, that wharf was made use of as a landing for steamers in place of the Baltimore Wharf, which was included within the site of the new wharf. The contractors commenced the actual work of putting down the iron piles of the new wharf on August 2, 1888. In the shoal water

near the shore the plans provided for disk piles, the depth of sand being sufficient to permit their use. These were sunk first, by the use of the water jet. Within the site of the old wharf numerous obstructions were met consisting of old piles, logs, and wrecks. When the contractors commenced driving wooden bearing piles the pile-driver which they had provided was found to be entirely insufficient for the work. From these causes the construction proceeded very slowly.

On August 10, 1888, an additional appropriation of \$75,000 was made by act of Congress for the enlargement of the wharf, as follows :

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War be, and he is hereby, authorized to cause the plans and specifications under which contract has been entered into by the United States for the construction of an iron wharf at Fortress Monroe, Virginia, to be amended and changed so as to require all bearing piles and floor beams of said wharf to be of iron or steel instead of wood, and to enlarge the dimensions of the said wharf as designated, and make such other modifications in the plans and specifications as may be required to meet the necessities of commerce, for which purpose the sum of seventy-five thousand dollars, or so much thereof as may be necessary, to be immediately available, be, and the same is hereby, appropriated out of any money in the Treasury not otherwise appropriated.

Approved August 10, 1888.

On September 6, 1888, I submitted a project to the Chief of Engineers for changes in the construction of the wharf, and for the enlargement of the same in accordance with the above act. It was recommended: (1) That steel beams be substituted for oak beams; (2) that the wooden bearing piles be creosoted; (3) that the wharf be enlarged by adding two panels (of 14 feet each) to the width, and three panels to the length; (4) that a wooden fender system be built outside of the iron wharf resting on creosoted wooden piles. The contractors proposed to do this work for prices which were reasonable, and which, for the most part, were the same as those under the original contract. The project was approved September 18, 1888, and on September 28, 1888, a supplemental agreement was entered into with the Groton Bridge and Manufacturing Company for the modified construction and enlargement of the wharf in accordance with the approved project, the prices of the work to be as follows: For wrought iron or steel, 5 cents per pound; for cast iron, $4\frac{1}{2}$ cents per pound; for pine lumber, \$33 per M feet, board measure; for oak lumber, \$42 per M feet, board measure; for creosoted wooden bearing piles for iron piles, in the extension of the wharf, \$30 per pile; for creosoted wooden piles for the fender system, \$24 per pile; for creosoting wooden bearing piles comprised within original design of the wharf, \$14 per pile. The creosoting was to be done with the best coal-tar creosote to the amount of 12 pounds per cubic foot. The time for the completion of the work was extended to April 1, 1889. Detailed drawings were prepared for the modified wharf during October and November, 1888, and copies furnished the contractors. In the mean time the construction at the site of the structure had proceeded very slowly. On the 1st of October, 1888, about 825,000 pounds of cast-iron piles had been delivered at the wharf, but up to the 15th of October only twenty-three piles had been put in position. There was also delay in ordering the steel beams.

The tools and appliances provided were not suitable, and the superintendence on the part of the contractors was unsatisfactory. On October 31, 1888, a letter was addressed to the contractors calling their attention to the delay and unsatisfactory progress of the work, and also to the requirements of the contract relating to this subject. On November 30, thirty-four piles had been put in. During December, 1888, a new pile-driver was received and fitted up, and after it was put in use (about

January 1, 1889) better progress was made with the pile-driving. The creosoted bearing piles were driven from a false work resting on intermediate wooden piles, the latter being drawn as the work proceeded. For convenience of construction the contractors were allowed to carry out the wharf in two sections, the easterly section comprising somewhat more than one-half of the entire structure. On February 1, 1889, the iron piles had been put in on the easterly section out to a line 168 feet from the shore. The winter proved to be generally favorable for operations of this kind, and with the exception of occasional delays of a few days from storms, the work proceeded continuously, although the rate of progress was still slow. On the 1st of April the piles on the easterly section had reached a line 280 feet from the shore. The work of filling the iron piles with concrete, bolting on the steel I beams, struts, and rods, and the laying of the flooring, was carried on at the same time, each class of work being kept several panel lengths behind the preceding class. On May 1, 1889, the piles on the easterly section of the wharf had all been put in, and work was commenced on the westerly section. On June 30, 1889, all the iron piles had been put in place, and nearly all of the creosoted wooden piles for the fender system driven. Steel beams, struts, and diagonal rods had all been put in place on the easterly section of the wharf, and the flooring of the same section nearly laid. Some beams had been fitted in place on the westerly section of the wharf. The old wharf has now been entirely removed.

The roadway between the wharf and Mill Creek Bridge was badly injured near the bridge by the severe storm and high tide of April 6, 1889. The Chesapeake and Ohio Railroad has permission to enter the reservation, and it is understood that it is to cross this roadway at a low grade and provide a new roadway crossing the tracks over grade. For this reason it seems advisable to delay repairs to the existing roadway.

The great storm of April 6, 1889, caused a considerable accretion to the shore at the site of the wharf, and may render it necessary at some future time to construct works to prevent the further encroachment of the shore line. The advance during this great storm referred to, was unprecedented.

Money statement.

July 1, 1888, amount available.....	\$9,670.31
Amount appropriated by act of August 10, 1888.....	75,000.00
	<hr/>
	84,670.31
July 1, 1889, amount expended during fiscal year, exclusive of	
liabilities outstanding July 1, 1888..... A	\$73,626.69
July 1, 1889, outstanding liabilities	8,147.26
July 1, 1889, amount covered by existing contracts.....	<hr/> 54,277.36
July 1, 1889, balance available.....	<hr/> 30,619.00

2 B.

IRON PILE-BRIDGE OVER MILL CREEK AT FORT MONROE, VIRGINIA.

The act making appropriations for sundry civil expenses of the Government for the fiscal year ending June 30, 1890, contained the following item of appropriation for the construction of an iron bridge over Mill Creek at Fort Monroe, Va.:

For the construction of an iron bridge over Mill Creek between the military reservation of Fortress Monroe and Elizabeth City County, Virginia, twenty thousand dollars, to be expended under the direction of the Secretary of War.

The work was assigned to my charge by letter of the Chief of Engineers, dated April 3, 1889. A project for the construction of a new bridge was submitted on April 9, 1889, and approved on April 12, 1889.

The proposed plan of construction is as follows: The new iron bridge is to be built on the site of the existing wooden pile-bridge, which will be kept open for travel until the new structure is completed. The bridge will be built of cast-iron piles arranged in bents of three piles each. The piles of each bent will be 10 feet apart from center to center, and the bents 20 feet apart in the direction of the length of the bridge.

The bottom of the creek is chiefly soft mud, so that disk piles could not be safely used. The iron piles will, therefore, be supported on wooden piles cut off about 2 feet above the bed of the stream. The iron pile will be cast so as to encase the wooden pile for a length of 6 feet (or for a distance of 4 feet below the bottom), and at the same time will have an ample bearing on the top of the wooden pile to support the weight coming from the bridge.

The iron piles will be cast in one, two, and three sections, depending upon the depth of water. In the deeper water the bent of piles will be braced by a system of sway bracing. At the tops of the piles the bents will be united in pairs by lateral bracing, so as to form a series of trestle towers. The floor beams will be of oak, and the floor joist and planking of pine. The width of the bridge will be 24 feet, and it will be provided with substantial hand-railings and wheel-guards.

Plans and specifications for the bridge have been prepared, and under date of June 25, 1889, an advertisement for proposals has been issued, the proposals to be opened July 25, 1889.

Money statement.

Amount appropriated by act of March 2, 1889	\$20,000.00
July 1, 1889, balance available	20,000.00

APPENDIX No. 3.

POST OF WILLETS POINT, NEW YORK—ENGINEER SCHOOL OF APPLICATION—BATTALION OF ENGINEERS—ENGINEER DEPOT.

ANNUAL REPORT OF LIEUTENANT-COLONEL WILLIAM E. KING, CORPS OF ENGINEERS, OFFICER IN COMMAND, FOR THE FISCAL YEAR ENDING JUNE 30, 1889.

UNITED STATES ENGINEER SCHOOL,
Post of Willets Point, New York Harbor, July 28, 1889.

GENERAL: I have the honor to submit the following annual report on the Post of Willets Point, N. Y., the United States Engineer School, the Battalion of Engineers, and the Engineer Depot.

POST OF WILLETS POINT.

At the close of the fiscal year the garrison consisted of 26 commissioned officers and 393 enlisted men (for roster and changes during the year see report of the battalion commander herewith), including the following general staff, artillery, and infantry officers:

Capt. E. C. Carter, assistant surgeon, U. S. Army.
First Lieut. J. L. Wilson, Fourth Artillery.
First Lieut. David Price, First Artillery.
First Lieut. Charles B. Hardin, Eighteenth Infantry.
First Lieut. Theo. De Witt, assistant surgeon, U. S. Army.
Second Lieut. James T. Kerr, Seventeenth Infantry.
Second Lieut. Elmore F. Taggart, Sixth Infantry.
Second Lieut. T. W. Moore, Twenty-second Infantry.
Second Lieut. W. S. Biddle, jr., Thirteenth Infantry.
Second Lieut. L. P. Davison, Eleventh Infantry.
Second Lieut. E. N. Jones, jr., Eighth Infantry.

Maj. J. C. G. Happersett, surgeon, U. S. Army, was relieved from duty at this post on April 22, 1889.

First Lieut. J. D. Glennan, assistant surgeon, U. S. Army, was assigned to duty at this post November 2, 1888, and relieved June 1, 1889.

Acting Asst. Surg. Theo. De Witt was assigned to duty at this post June 1, 1889. He was appointed assistant surgeon with rank of first lieutenant to date June 7, 1889, as per circular from Adjutant-General's Office June 10, 1889. He is at present, and since June 5, 1889, on duty with detachment of engineer troops at Johnstown, Pa.

Three artillery officers and seven infantry officers were assigned to duty at this post in Special Orders No. 276 and 280, headquarters of

the Army, series of 1888, for special instruction in the Torpedo Service. First Lieut. J. L. Wilson, Fourth Artillery, was relieved from this duty to date July 1, 1889, and Second Lieut. R. P. Davis, Second Artillery, was relieved on June 16, 1889; the other officers are still under instruction at the post, as per authority contained in letter dated Adjutant-General's Office, June 18, 1889.

The following improvements have been made during the year :

I. The system of brick sidewalks referred to in my last annual report as having been commenced by the Quartermaster's Department has been nearly completed. In all, some 4,500 feet of walk have been laid.

II. The roads upon the reservation have been graded and improved with a covering of broken stone, furnished partly by the Quartermaster's Department and partly from loose stone picked up and broken by enlisted men.

III. A suitable gate of wrought iron with cut-stone posts has been erected at the entrance to the post, upon the reservation line. This, with the addition of several hundred feet of substantial iron fence which is expected from Washington, and which will be placed on the same line, will greatly improve the appearance of the main approach to the post.

IV. The old hospital building has been converted into an office building and furnishes a suitable and commodious post headquarters, while the building formerly used for the latter purpose has been fitted up as four sets of quarters for unmarried officers.

V. The old building formerly used as an officers' mess, having become uninhabitable and dangerous, has been torn down and removed.

VI. The fence around the post cemetery has been completed.

VII. The soldiers' laboratory, for which money was appropriated last year, has been completed and is in use, and a suitable fire-proof building for the collection of engineering models will be erected during the coming year, Congress having appropriated \$8,000 for the purpose.

VIII. The post canteen, to which reference was made in my last annual report, was started April 29, 1889, and is now in successful operation and paying a handsome sum to the several company funds.

IX. On June 29, 1889, a combined mess for the companies of the Battalion of Engineers stationed at this post was put in operation. The old building used for company kitchens and mess-rooms was used for this purpose, and with a few alterations, involving no expense, will serve its purpose until a suitable one can be built. This arrangement, economizing as it does both labor and material, must, with the assistance of the funds derived from the canteen, add greatly to the health and comfort of the enlisted men.

X. The target range has been improved during the year, by the removal of the old butt, which was arranged for two Laidley's revolving targets, and the construction of a new butt, 100 feet long, arranged for five sliding targets (Cushing); the new butt was built in rear of the site of the old one and so arranged as to admit of practice at 800 yards, hitherto impracticable. A causeway has been constructed over the marshy parts of the range, so that now a limited amount of skirmish practice can be had. All of this work was done by enlisted men.

In case money is made available for the construction of the new barracks, it is proposed to utilize the best of the material in the old ones in repairing the frame buildings on the post used as quarters for married soldiers. These buildings, occupied by deserving soldiers of many years' service, are very badly in need of repairs.

I would again earnestly recommend the following additional improve-

ments, which are greatly needed both for the proper and economical administration of the affairs of the post and to secure the health and comfort of the garrison.

I. The new barracks recommended in last three annual reports and by a special Board of officers, and for which plans and specifications have been submitted, are greatly needed. The repairs of the old barracks, built of a combination of old and new material many years ago, are yearly becoming more extensive, and will soon exceed the value of the buildings themselves; their location, which was fixed by certain unfortunate limitations, can be greatly improved. They were built when the companies were about half their present size and are now overcrowded, although the number of men is still below the limit authorized by law.

In this connection I would respectfully invite attention to the following quotations from a recent report of Capt. E. C. Carter, assistant surgeon, U. S. Army, post surgeon:

It will readily be seen, then, that an overcrowded condition of a barrack must be a source of great danger to its occupants. If, in addition to an overcrowded condition, there are no adequate means by which the foul air may be withdrawn and fresh air properly warmed, and not in draughts, may be introduced, the danger is graver. If these further conditions are added, viz, that the sleeping-rooms are heated by stoves which can not be gas-tight, and therefore add considerable CO₂, and some of the more pernicious CO to the already vitiated atmosphere, and that the walls of the rooms are so thin that sudden changes of temperature are likely to occur when the fires become low, * * * it will be obvious that much illness and suffering must result.

The condition of the barracks at this post is about as represented above. It hardly seems strange, therefore, that the percentage of men taken sick should be large. Most of the cases of illness are of the kinds produced by poor ventilation, probably in connection with a somewhat defective diet. Of bronchitis there were 336.86 cases per 1,000 in 1888. Of diarrhoea and kindred diseases 489.48 cases per 1,000 in 1888. While the total admissions to the sick-report for 1888 were 2,342.13 per 1,000.

For the six months beginning January 1, 1889, and ending June 30, 1889, the percentage of admission is 1,384 per 1,000. * * *

The condition of the guard-house is even more unhygienic than that of the barracks at this post.

Careful policing and cleaning are the rule in these buildings, but the defects are of a too radical nature to be thus remedied.

There is, of course, no difficulty in providing plenty of openings for admission of fresh air, but this is very far short of proper "ventilation;" men will risk impure air rather than suffer from cold air, and dormitories for large numbers of men must be large enough and the fresh air must be heated enough to make the necessary change of air without producing draughts or uncomfortably low temperatures. This can only be done properly and economically in the present instance by building the new barracks as already proposed.

II. As stated in my last annual report, the quartermaster and commissary warehouses, coal yard, etc., are located at the extreme end of the post, and as far as possible from the wharf on which all supplies and stores must be landed.

The extra cost of hauling coal, every ton of which has to be hauled nearly a mile more than is necessary, would alone be a sufficient reason for changing the location; in addition to this, however, the buildings are old, not worth repairs, and entirely inadequate to the needs of so large a garrison.

Plans and specifications for a suitable building of moderate cost were prepared last year by the post-quartermaster and acting commissary of subsistence and submitted to the quartermaster-general, U. S. Army. I would again respectfully recommend them for favorable consideration.

There is no suitable place for storing the annual supply of coal, and great loss occurs from this source. This building provides a suitable shelter for the coal, as well as for other supplies.

III. "The reservation is bounded on the west by a salt marsh, with a sluggish lagoon in the middle, and at low tide there is nothing to prevent unauthorized persons from entering or leaving the post without passing the guard-house, especially at night or in case of heavy fogs, which often prevail. I believe it was part of the original design for the land defense of this place to clean out and deepen this lagoon and extend a broad ditch as far as the main road leading past the guard-house. This could be done without any great expense if a small dredging-machine could be borrowed from some of the Government works in the vicinity when not needed for other purposes. This work, if done, would greatly improve the sanitary condition of the post, and would, at the same time, reclaim considerable land, which is greatly needed for post gardens and for a target range. The present range is too low and can not be used for skirmish firing.

"This would also make a suitable harbor for laying up our boats in winter, where they will be protected from ice and storms."

IV. It has long been my intention to begin a gradual process of grading the parade ground, but there has been no time when it could be advantageously undertaken. The ground is not only quite irregular in general surface, but is crossed by furrows and broken up by small depressions that make it very difficult to march over. The soil is so thin that, when graded, rich earth will have to be added in places to give proper support to the grass.

V. The ice pond should be walled and the earth so embanked around it as to prevent surface water from entering it. As now arranged, the post surgeon objects to the use of the ice excepting for cooling purposes. This work can be done from time to time by details of enlisted men, a large quantity of stones having already been picked up and hauled to the pond for that purpose.

VI. The sanitary condition of the post during the year, with the exceptions noted above, has been satisfactory.

Only one death, caused by "pernicious remittent fever," occurred at the post during the year.

One soldier belonging to the post was found dead at College Point, Long Island; cause, suicide from an overdose of poison while absent without leave.

VII. The rapid strides now making in the use of electricity for illuminating purposes point to the conclusion that it will soon supersede all other methods where suitable facilities are available.

We are now so situated that the entire post should be lighted by electricity, but the grounds and barracks could be so lighted at a very trifling expense, as we have boilers, engines, dynamos, plenty of wire for mains, and men who could put up and operate the system. All that would be needed would be the lamps, some service wires, and a few accessories.

This matter pertains to the Quartermaster's Department, and I would respectfully recommend that the Quartermaster-General, U. S. Army, be requested to authorize a trial of this method of lighting at this post, and I believe it will soon be found desirable to introduce it at all large military posts. The oil now used would go far towards paying for the fuel and lamps, while the additional safety, cleanliness, and brilliancy of the light would make it a valuable improvement over any other means of illumination.

UNITED STATES ENGINEER SCHOOL.

The scope and object of the school have been fully set forth in previous reports and in the order establishing it on its present basis; the orders issued in pursuance of the latter, arranging the details of the season's work, are appended marked A, B, and C.

During the past year a class of five engineer officers completed the full course of three years, and two officers of artillery, having completed the seven months' course of torpedo instruction, were relieved in June.

The following tabular statement shows the constitution of each class, the subjects in which they have received instruction, and their marks in each subject for the year, the maximum in all cases being 3.

These marks are the mean of marks awarded at examinations held as follows: January 4, 1889, February 5, 1889, March 7, 1889, April 15-23, May 9, 10-13, 1889.

Third winter's class.	Civil engineering.	Military engineering.
First Lieut. H. C. Newcomer, Corps of Engineers.....	2.885	2.975
Second Lieut. M. M. Patrick, Corps of Engineers.....	2.837	2.95
Second Lieut. C. S. Riche, Corps of Engineers*.....	2.815	2.95
Second Lieut. T. H. Rees, Corps of Engineers.....	2.887	2.95
Second Lieut. C. L. Potter, Corps of Engineers.....	2.78	2.80

Second winter's class.	Civil engineering.	Military engineering.	Military photography.
Second Lieut. F. R. Shunk, Corps of Engineers.....	2.81	2.71	3.0
Second Lieut. J. J. Meyler, Corps of Engineers.....	Absent.	Relieved.	.....
Second Lieut. E. W. Van C. Lucas, Corps of Engineers...	2.71	2.54	Not examined.

First winter's class.	Torpedoes.
First Lieut. J. L. Wilson, Fourth Artillery.....	2.85
First Lieut. David Price, First Artillery.....	2.664
First Lieut. C. B. Hardin, Eighteenth Infantry.....	2.632
Second Lieut. J. T. Kerr, Seventeenth Infantry.....	2.946
Second Lieut. E. F. Taggart, Sixth Infantry.....	2.43
Second Lieut. T. W. Moore, Twenty-second Infantry.....	2.30
Second Lieut. W. S. Biddle, Jr., Thirteenth Infantry.....	2.86
Second Lieut. L. P. Davison, Eleventh Infantry.....	2.87
Second Lieut. E. N. Jones, Jr., Eighth Infantry.....	2.42
Second Lieut. R. P. Davis, Second Artillery.....	2.996
Second Lieut. E. W. Van C. Lucas, Corps of Engineers.....	2.684
Second Lieut. Henry Jervey, Corps of Engineers.....	2.98
Second Lieut. C. H. McKinstry, Corps of Engineers.....	2.86
Second Lieut. W. V. Judson, Corps of Engineers.....	2.802

* No project; relieved April 6, 1889.

I. The library of the school is under the immediate charge of the battalion adjutant, *ex officio* secretary of the academic staff, and has received many valuable additions during the year in the way of standard scientific works and periodicals.

The appropriation asked for to keep the library up to the proper standard during the next fiscal year is \$500, which is respectfully recommended.

II. In accordance with my recommendation of last year the school was thrown open to officers of cavalry and infantry, in addition to the artillery officers already provided for, and a detail of seven infantry officers have been under instruction since December 1, 1888. They have

all evinced commendable interest in their work and have acquitted themselves very creditably.

It having been found impracticable to give to all these officers the requisite practical instruction in the torpedo service within the limit of 7 months, those who had not completed out-door work on July 1, 1889, were authorized to remain until October 1, next (per authority contained in letter of Adjutant General, June 18, 1889.) In view of the experience of the past year and with the prospect of a still larger number of officers for instruction, I would respectfully recommend that the course be changed from 7 to 10 months, to begin December 1, and end October 1.

BATTALION OF ENGINEERS.

The law provides for 5 companies of engineer troops, having an authorized strength of 752 enlisted men, officered by detail from the Corps of Engineers. At present only 4 companies, with a total strength of 500 enlisted men, are allowed to be recruited.

The aggregate strength of the battalion on June 30, 1889, was 17 commissioned officers and 404 enlisted men.

During the past year companies A, B, and C have been stationed at Willets Point. Company D exists in name only. Company E has been stationed at West Point to assist in the practical instruction of cadets of the Military Academy in building military bridges, sapping, mining, and signaling. The authorized enlisted strength of the company, with the approval of the Major General commanding the Army and the Secretary of War, was on June 13, 1889, increased from 50 to 100 men, making the authorized maximum enlisted strength of the battalion of engineers 500 men.

The following is a roster of officers serving with the battalion of engineers on June 30, 1889, viz:

Lieut. Col. W. R. King, Corps of Engineers, commanding.
First Lieut. J. G. Warren, Corps of Engineers, adjutant.
First Lieut. G. A. Zinn, Corps of Engineers, quartermaster.

Company A.

Capt. S. W. Roessler, Corps of Engineers, commanding company.
Second Lieut. M. M. Patrick, Corps of Engineers, on detached service at Johnstown, Pa.
Second Lieut. Thos. H. Rees, Corps of Engineers, on detached service at Johnstown, Pa.
Second Lieut. E. W. Van C. Lucas, Corps of Engineers, with company.
Second Lieut. W. V. Judson, Corps of Engineers, with company.

Company B.

Capt. R. L. Hoxie, Corps of Engineers, commanding company.
Second Lieut. F. R. Shunk, Corps of Engineers, with company.
Second Lieut. H. Jervey, Corps of Engineers, with company.

Company C.

Capt. E. Bergland, Corps of Engineers, commanding company.
First Lieut. H. C. Newcomer, Corps of Engineers, with company.
Second Lieut. C. L. Potter, Corps of Engineers, with company.
Second Lieut. C. H. McKinstry, Corps of Engineers, with company.

Company D.

First Lieut. J. G. Warren, Corps of Engineers, commanding company

Company E.

Capt. G. McC. Derby, Corps of Engineers, commanding company.
First Lieut. J. Biddle, Corps of Engineers, with company.

The following table shows the changes that have taken place in the personnel of the officers during the year, viz :

Rank.	Names.	Date.	Joined or relieved.	Remarks.
First lieutenant.....	Hale, Irving.....	Aug. 27, 1888	Relieved..	S. O. 85, A. G. O., Apr. 13, 1888.
Captain.....	Maguire, E.....	Nov. 2, 1888	do.....	S. O. 209, A. G. O., Nov. 17, 1888.
Captain.....	Price, P. M.....	Jan. 4, 1889	do.....	S. O. 209, A. G. O., Nov. 17, 1888.
Second lieutenant.....	Meyler, J. J.....	Jan. 7, 1889	do.....	S. O. 302, A. G. O., Dec. 29, 1888.
Second lieutenant.....	Riches, C. S.....	Apr. 2, 1889	do.....	S. O. 73, A. G. O., Mar. 29, 1889.
Second lieutenant.....	Lucas, E. W. V. C.....	July 20, 1888	Joined.....	S. O. 149, A. G. O., June 28, 1888.
First lieutenant.....	Zinn, G. A.....	Aug. 27, 1888	do.....	S. O. 188, A. G. O., Aug. 15, 1888.
Second lieutenant.....	Judson, W. V.....	Sept. 30, 1888	do.....	S. O. 306, A. G. O., Sept. 7, 1888.
Second lieutenant.....	Jervey, H.....	Sept. 30, 1888	do.....	S. O. 206, A. G. O., Sept. 7, 1888.
Second lieutenant.....	McKinstry, C. H.....	Sept. 30, 1888	do.....	S. O. 208, A. G. O., Sept. 7, 1888.
Captain.....	Hoxie, R. L.....	Jan. 22, 1889	do.....	S. O. 269, A. G. O., Nov. 17, 1888.
Captain.....	Derby, G. McC.....	Jan. 4, 1889	do.....	S. O. 209, A. G. O., Nov. 17, 1888.

First Lieut. Irving Hale, Corps of Engineers, was relieved from duty as battalion quartermaster, in Orders No. 68, Battalion of Engineers, and from duty as acting assistant quartermaster and acting commissary of subsistence, post of Willets Point, in Orders No. 180, United States Engineer School, August 27, 1888.

First Lieut. G. A. Zinn, Corps of Engineers, was appointed battalion quartermaster, in Orders No. 68, Battalion of Engineers, and acting assistant quartermaster and acting commissary of subsistence, post of Willets Point, in Orders No. 180, United States Engineer School, August 27, 1888.

RECRUITING.

During the year the companies of the Battalion of Engineers have been recruited partly by enlistment and re-enlistment at Willets Point and West Point, partly by assignment on their own application of recruits from principal depot recruiting service at Davids Island, New York Harbor and Columbus Barracks, Ohio, and partly by recruits obtained at a rendezvous in New York City. Under authority granted in letter from Adjutant General U. S. Army, dated September 15, 1888, an engineer sergeant was detailed to report to the superintendent recruiting service to recruit for the battalion. He was attached to the rendezvous at 157 Hudson street from September 28, 1888, until May 24, 1889, when he was attached to the rendezvous at 146 Park Row, where he still remains.

The following is a summary statement of the recruiting, desertions, and other changes among the enlisted men of the Battalion of Engineers during the past year, viz :

Gain :		
Recruits from depot.....	12	
Enlisted.....	90	
Re-enlisted.....	29	
By transfer.....	2	
From desertion.....	5	
Total.....	138	
Loss :		
Discharged by expiration of service.....	47	
Discharged for disability.....	11	
Discharged by general court-martial.....	5	
Discharged by order.....	21	
Discharged by civil authority.....	1	

Loss—Continued.

Transferred.....	10
Retired.....	1
Died.....	3
Deserted.....	23
Total.....	122

The following table exhibits a synopsis of the engineer recruiting service, the average number of men in confinement and sick, the number of desertions and trials by general and garrison courts-martial from June 30, 1884, to June 30, 1889, a period of five years.

Date.	Number of men on June 30.	Recruiting.		Average daily number.		Desertions.	Trials.	
		En-listed.	Re-en-listed.	Confined.	Sick.		General court-martial.	Garrison court-martial.
June 30, 1884, to June 30, 1885 ..	383	56	30	6	18	106	11	59
June 30, 1885, to June 30, 1886 ..	396	37	38	8	22	76	20	107
June 30, 1886, to June 30, 1887 ..	388	20	28	9	17	49	19	160
June 30, 1887, to June 30, 1888 ..	*397	9	24	12	22	49	21	218
June 30, 1888, to June 30, 1889 ..	*402	90	29	6	20	23	4	214

* NOTE.—The figures for 1888 and 1889 include nine men in Hospital Corps, transferred from the Battalion of Engineers, December 14, 1887, and who are now at this post.

From the above it will be seen that at the close of the present fiscal year, with a greater number of enlisted men than at any previous time during the past five years, the number of desertions was less than one-half the smallest number reported within the same period, which speaks well for the present system of recruiting.

DISCIPLINE.

It will be noticed that the number of court-martial cases is quite large, but they are mostly for mild cases of "absence without leave" and "conduct prejudicial to good order and military discipline," which were formerly punished arbitrarily without trial.

The number of delinquents is not so great as would appear, a few disorderly characters by repeated trials making up the greater part of the number. Several of these worthless men have been got rid of during the year, and it is hoped that next year's showing will be improved by their absence. On two or three occasions during the year the guard-house has been entirely without prisoners, which is an almost unheard-of occurrence at this post.

One of the chief causes of delinquency is the fact that in going to and from the post a soldier has to run the gantlet of saloons, distributed along the way, and it is hoped that the post canteen will be an assistance to those who desire to remain on the post and avoid the temptation to indulge in strong drink.

I believe the efficiency of this command, as well as of the whole army, would be promoted by the following changes of regulations:

I. Reduce the term of enlistment to *three* years and of re-enlistments to *one* year. This would greatly diminish the pressure of dissatisfied men, and those who have better prospects outside, to leave the service by desertion or through the influence of friends.

II. Allow cases of desertion to be tried by garrison courts, unless

the accused demands a general court, and award suitable punishment, subject to approval of the General of the Army.

III. Allow minor offenses, now triable by garrison courts, to be tried, and punishment such as fine or confinement at hard labor, awarded by a field officer or captain other than the commanding officer of the prisoner, unless the latter demands a garrison court; the sentence to be subject to approval by the post commander.

The last two suggestions would, I think, tend to secure prompt as well as substantial justice, and thus save valuable time as well as give the prisoner a speedy trial. In the great majority of cases the prisoner pleads guilty and makes no defense; in fact charges are seldom preferred without a previous investigation. If the man don't even pretend that he is innocent, why should the legal farce of a formal trial be enacted? When any doubtful case arises the prisoner can secure his rights as at present by asking for a court, but in the general case he would prefer to be sentenced at once so as to avoid delay. A scale of punishments for the more frequent offenses should be prescribed in orders, to be used as a basis in awarding sentences.

DRILL AND INSTRUCTION.

During the year the Battalion of Engineers has been drilled and instructed as follows:

1. Infantry tactics, school of the soldier, company and battalion.

2. In target practice, during the month of June. In last target year 121 men qualified as marksmen and 7 men as sharpshooters.

In the rifle contests at Fort Niagara, five prizes of the available fifteen were won by the battalion team as follows:

In the Department of the East match: Sergt. Martin Doolan, Company B, won first prize, gold medal; and first prize, silver medal (skirmish).

In the Division of the Atlantic match: First Lieut. Irving Hale, Corps of Engineers, won first prize, gold medal; and first prize, silver medal (skirmish). Sergt. Martin Doolan, Company B, won fifth prize, silver medal.

In the rifle competitions at Creedmoor the battalion team took first prize for the third time in the Sheridan skirmish match, and second prize in the Hilton trophy match.

Second Lieut. Charles L. Potter, Corps of Engineers, won fifth prize in Stewart's match.

Sergt. George Doyle, Company A, won first prize in the President's match for the mid-range military championship of the United States; second prize in Stewart's match, and money prize in Governor's match.

3. In pontoniering during the months of August and September, including rowing and building canvas ponton and trestle bridges, as prescribed in the ponton manual.

4. In military engineering, including field fortifications, sapping and military mining.

5. Torpedo drills were had throughout the year, the winter months being devoted to indoor drills and practice in the loading room, and the summer months to outdoor drills and exercises.

6. Photography. Selected details of non-commissioned officers have been instructed in military photography.

In compliance with telegraphic instructions from the Chief of Engineers, a detachment commanded by Capt. Eric Berglund, Corps of Engineers, and consisting of Second Lieuts. M. M. Patrick and Thomas

H. Rees, Corps of Engineers, 4 sergeants, 2 corporals, and 62 privates, left Willets Point, at about 7 a. m., June 5, 1889, and proceeded to Johnstown, Pa., or vicinity, for the purpose of assisting in bridging such streams as might have been rendered impassable by the recent floods. This detachment was accompanied by a medical officer, Asst. Surg. Theodore De Witt, U. S. Army, and 1 acting hospital steward with medical supplies. The detachment was provided with 4 horses, 2 ponton and 2 chess wagons, 9 wooden ponton boats, with balk and chess complete, 9 canvas ponton boats, complete with chess, 7 bridge trestles with balk and chess complete, material sufficient to construct a bridge about 500 feet long, or, excluding the canvas pontons, 350 feet long. Also equipment of tools and material for repairs.

A detachment of 2 sergeants, 2 corporals, and 26 privates, of Company E, under command of First Lieut. John Biddle, Corps of Engineers, left West Point, N. Y., on June 5, 1889, with 11 pontons and proper complement, for similar duty, at Johnstown, Pa.

This detachment was relieved on June 17, 1889, and with 16 men, of the Willets Point detachment, under command of Capt. Eric Bergland, Corps of Engineers, returned and arrived at their respective stations on June 18, 1889.

The following resolution was adopted by the Finance Committee:

Resolved, That the thanks of the Finance Committee, on behalf of the citizens of Johnstown, be tendered to the United States soldiers, who have furnished to us most generously, and in full measure the means of communication between our communities divided by flooded and bridgeless rivers, thus enabling us to get back to our accustomed employments. We know that they have had a difficult and laborious tour of duty, and have in every way manifested their heartfelt sympathy with our suffering people.

Certified from the minutes.

CYRUS ELDER,
Secretary.

It has often been suggested that discharged engineer soldiers, and under special conditions some of those still in service, might be employed to a greater extent than at present on the various public works carried on by our officers. During the past few years, I have been able to secure employment for quite a number of deserving men, and this has almost without exception resulted in substantial benefit to the public interest as well as to the men. In a letter dated May 16, 1889, Captain F. A. Mahan, Corps of Engineers, proposed a detailed plan for placing deserving non-commissioned officers on a kind of supernumerary list, and employing them on various works for which there were appropriations as overseers, draughtsmen, time-keepers, etc., and this paper has been sent informally to a number of our officers who have had experience in such matters for an expression of their views on its feasibility. Several replies have been received, from which it appears that the subject has attracted considerable interest, and when they are all in the matter will be forwarded to the Chief of Engineers with a special report and recommendations.

ENGINEER DEPOT.

PUBLIC BUILDINGS AND CONSTRUCTIONS.

I. The new library has been provided with suitable book-cases made by the soldiers from such lumber as remained on hand after the completion of the building, and the books have been transferred to it and properly arranged.

II. The soldiers' laboratory, 40 by 60 feet, and two stories high, has also been completed and occupied. An addition to this building 20 by 30 feet, and one and a half stories high, for the boilers, engines, and dynamos required for the electric search-light, fish torpedo, and other purposes, has been built and occupied. The machinery has been set up in this building, substantial piers and chimney having been built for the purpose, and the entire structure has been found well suited to the purpose for which it was designed. The cost of the building with the addition referred to, and including boiler and pipes for steam-heating, has been \$6,500, or exactly the amount of the appropriation. With exception of the tin roof, all this work, including the setting up of the boilers, engine, and dynamo, has been done by engineer soldiers.

III. Having been unsuccessful in getting any satisfactory proposition from the contractors who built the steamer *Bushnell* for making the necessary repairs and alterations referred to in my last report, it was decided to undertake the work ourselves, getting such parts of the machinery as required special skill and appliances at different machine-shops and foundries, where they could be procured most advantageously. The engines and other parts needing alterations have been taken out and are now being replaced in their new form with every prospect of successful result. The main shaft, with the propeller and rudder, will soon be in place, and the hull has been painted preparatory to launching. The engines have been adapted to the new position of the shaft, and are being set up as rapidly as possible. A "Lighthall" surface-condenser has been substituted for the exposed pipes formerly attached outside of the keel, and which were easily damaged whenever a torpedo or other submerged obstacle was struck. This work is being done under the superintendence of Ordnance Sergt. William H. Brown, who has shown great intelligence and ingenuity as well as industry in carrying on this difficult undertaking.

IV. Considerable work was done in repairing some of the old ponton boats for use in the ponton drills during the summer. Although they have been on hand nearly thirty years, most of the time exposed to the weather, some of these old boats are still in a tolerable state of preservation, and some of them even stood the rough journey to Johnstown, Pa., and return, without serious damage. Of course, they could never be relied on in an active campaign, and they must soon be replaced, even for purposes of drill.

V. *Lightning-rods.*—The frequency with which trees and other objects in this vicinity have been struck by lightning, suggests that some protection should be provided to all the more important buildings on the post, and it is thought that some of the unserviceable torpedo cable can be used to advantage for that purpose. The armor and core together would make a conductor of sufficient cross section, and it can be put up at trifling cost. During one storm, a few weeks ago, two large buildings were struck, but fortunately the damage done was slight, and was easily repaired. In one case, a man stood within 20 or 30 feet of a cornice that was splintered and thrown a considerable distance, but he was not even knocked down. In the other case, the gable of a large store-house was struck, and the track of the lightning apparently passed down across a window to the earth, and then struck off some distance through the grass, and finally into the ground, apparently on its way to a pipe line, some 3 feet below the surface.

VI. The roof of the officers' laboratory was repainted. The roofs of some of the ponton sheds were repaired from materials obtained by pull-

ing down some of the other sheds that are no longer needed, and other necessary repairs to the depot buildings have been made.

VII. An additional derrick was erected on the long wharf, to give additional facilities for handling torpedo materials.

DEPOT PROPERTY.

The surveying, astronomical, and other instruments in the depot have been properly cared for, and the following additions have been made during the year by purchase, viz:

Two sextants, 4 transits, 2 engineer levels, 11 metallic tapes, 10 steel tapes, 5 binocular field glasses, 10 steel chains, 8 leveling rods, 5 hand levels.

The following instruments have been received in depot from officers on public works, viz:

Eight theodolites, 3 engineer levels, 1 plane table, 2 gradienters, 1 astronomical transit, 10 prismatic compasses, 6 odometers, 1 barometer aneroid, 3 sets drawing instruments, 3 pocket compasses, 1 sextant, 3 steel chains.

The following instruments have been transferred to officers of the corps and to acting engineer officers on public works, viz:

Six engineer levels, 3 sextants, 1 gradienter, 1 plane-table, 4 current meters, 2 odometers, 6 theodolites, 1 standard yard, 2 surveyor's compasses, 11 hand levels, 9 pocket compasses, 3 Abbot's protractors, 1 boat compass, 5 level rods, 6 aneroid barometers, 7 thermometers, 4 steel chains, 13 prismatic compasses, 2 sets of pins, 2 metallic rulers, 1 metallic triangle, 6 metallic tapes, 4 steel tapes, 3 binocular field glasses, 2 sounder instruments, 1 circular protractor, 2 sets drawing instruments.

Most of the repairing of the instruments during the year has been done by detailed enlisted men of the battalion, and the cost has been very much less than it would have been if the instruments had been sent out to private shops, while the character of the work done has been satisfactory.

The following instruments have been overhauled, cleaned, and put in good order during the year, viz:

Sixteen prismatic compasses, 2 engineer levels, 1 standard yard, 1 plane-table, 4 steel scales, 1 gradienter, 2 current meters, 2 transits, 3 steel chains, 1 sextant, 2 steel tapes, 3 theodolites, 2 engineer levels, 1 hand level, and a number of smaller instruments, and minor repairs on instruments not mentioned above.

Electrical test instruments have been also repaired in the depot repair-shop to advantage, but such instruments as could not be repaired here were sent to private shops, and the expense during the fiscal year including bills paid for repair of instruments at distant places, paid in accordance with instructions from the Chief of Engineers, amounted to \$165.80.

As no electrical instruments have been bought for several years, during which time many new and improved forms have been devised, it was found necessary to purchase quite a number of these instruments for use in the laboratory as well as to illustrate the progress now making in these matters both in this country and in Europe. Some of these instruments have been received and others are daily expected. Among these instruments are ammeters and voltmeters of some of the most approved patterns, adapted to all measurements likely to be required.

EXPERIMENTS.

The appropriation for continuation of torpedo experiments was not available until November 5, 1888, and, as explained in former reports, there had been no appropriation for this purpose for the two preceding

years, so that all the experiments that could be attempted were such as could be made with the materials on hand or that could be improvised without much expense. During this time we were also greatly crippled, both in making experiments and in the instruction of soldiers in planting and operating torpedoes, by the failure of the steam-launch and the propeller *Bushnell*, both of which gave out last fall and could not be made ready for this season's work. By borrowing a steam-launch from the Navy Department, the difficulty has been, in a measure, overcome, and it is hoped the *Bushnell* will soon be in use again, but the other boat will not be worth repairing and can only be used as a raft for carrying materials.

I. *Tests of explosives*.—The apparatus for testing high explosives was repaired and other preparations were made early in the spring for such tests as might appear desirable, and samples of emmense were ordered for trial, but an accidental explosion occurred at Dr. Emmens' works just as he was ready to ship the explosive, destroying the works as well as the samples, and he has not been able to replace them. He states, however, that he expects to be able to furnish some of his powder at an early day, and it will be tested as soon as received.

Samples of roburite were also promised, but have not been received.

In this connection it may be proper to state that, although the number of different explosives has nearly reached three hundred and fifty, none have been discovered which give any great promise of superseding gun-cotton and dynamite for sea mines; and for all purposes, both military and industrial, only a very limited number of the so-called inventions will probably ever be brought into general use.

II. *Crater gauge*.—Some additional experiments were made with the crater gauge, and it was intended to take it into deep water, but owing to the breaking down of the *Bushnell* this could not be conveniently done, but will be tried later.

In addition to the conclusions given in my last report, it has been found, or, at all events, "the indications are":

1. That for each charge there is a depth at which the crater will be spheroidal in form, while at greater or less depths it will be "pear-shaped," the smaller end being downward for less depths, and upward for greater depths.

2. The surface (not the volume) of the crater appears to vary about with the weight of the charge, the latter being of musket powder.

3. It makes but little difference whether the slides are set close to the ring at the center, or at considerable distance, provided, of course, they are inside the limits of the crater due to the given charge.

Four additional wires and slides were inserted near the vertical wire in order to get a more accurate record of what takes place in that direction.

It should be explained that the apparatus in question consisted of a wooden frame 15 by 20 inches square, with radial wires running from a thin iron ring at the center, the whole figure being something like a spider's web, with wooden slides on the wires so arranged as to be of the same density as water, and to leave a small rubber washer at the extreme point, to which they are carried by the explosion. The charge (which is necessarily small, from $\frac{1}{2}$ to 5 pounds) is placed in the center of the ring, and the whole frame is lowered vertically into the water to the desired depth just before firing. Plate I shows some additional results obtained with this apparatus.

III. *Pressure gauge*.—Another apparatus for accurate measurement of small pressures, such as would result from the explosion of a small

charge, or from a large one at considerable distance, is shown on Plate II. It consists of a compressible cushion to receive the pressure and a steam-gauge to register it, these parts being connected by an iron pipe of suitable length, and having an attachment for a bellows or air-pump. If this cushion be placed at the desired depth and distance from the charge to be fired, it is evident that any compression of the water would compress the air in the cushion, and cause a sudden rise in the index of the gauge. This, however, would give a ballistic effect instead of a statical one, and to avoid this difficulty it is necessary to compress the air in the cushion and gauge to about the pressure expected from the explosion. If the pressure from the explosion does not exceed this assumed pressure, no perceptible rise will be observed in the index, but if a rise is noted it will give a good idea of the proper pressure at which the gauge should be set for the next explosion. The results obtained show that this is by far the most accurate method yet devised for measuring small pressures, and the facility with which it may be used renders it a very convenient instrument for investigating the effect of explosions at considerable distances and the law governing such effects.

It has been found that a charge of 10 pounds of mortar powder, 10 feet below the surface and 10 feet horizontally from the gauge, will not give a pressure of more than 10 pounds per square inch. Arrangements are nearly perfected for giving this method a thorough trial, and the results will be reported later.

IV. *Torpedo drill*.—Five grand groups of torpedoes were planted during the season by different detachments of officers and men. When a group has been planted and tested, its position is located on the chart and a tracking drill with search lights is ordered. The officers are required to superintend all the details of the instruments, dynamo, and projectors. A steam-launch is followed in various directions through and across the group, and a small charge of dynamite is fired whenever she is judged to be dangerously near the torpedo which it represents. The fuses in the torpedoes are also fired, and a record made of the fact when a torpedo is taken up.

The object of this drill is twofold; it accustoms the officers and men to the duty of handling, planting, and operating the system, and it furnishes reliable data for correcting defects in the system and in the methods of using it.

The Mangin projector, ordered several months ago from Messrs. Sauter, Lemmonier & Co., of Paris, has been delayed much longer than it should have been, but the makers now promise to send it at once, and it will be set up and tested as soon as it arrives.

V. *Range finders and position indicators*.—One of the most important instruments yet to be invented is a quick, simple, and reliable instrument for determining the distance of moving objects. Several of the young officers have been set to study this problem, and a number of different instruments for the purpose have been tested and studied, but nothing satisfactory has been found. It is proposed to continue the investigations, however, and one or two new instruments will be constructed in the near future.

VI. Several photographs of explosions in air and water have been made, but they are not yet satisfactory, and it is hoped that better ones may be taken. Some of those taken by Lieutenant Hale and Sergeant Von Sothen, six in number, marked IV¹ to IV⁶, inclusive, are forwarded herewith. In some cases powdered magnesium was used to increase the actinic effect, but with ordinary powder the flame is distinctly visi-

ble. The charge used, and other circumstances under which the pictures were taken have been noted on each photograph.

VII. In order to ascertain whether some parts of the system could be improved, a Board of officers was convened to examine into the subject and report on the advisability of further experiments in connection with mooring rope, shackles, cut-off boxes, torpedo cases, etc.

A copy of the order, instructions, and reports of the Board is forwarded herewith, marked D. It is not, however, in a condition for definite action, being merely a preliminary step, and it is forwarded to show the line of investigation it is proposed to follow. The papers will, however, explain themselves.

VIII. A number of specimens of building stone have been tested at the request of officers engaged on river and harbor works. Lieutenant Reese has attended to this duty, and has obtained very satisfactory results, considering the facilities at hand.

A "Jolly" spring balance for specific gravity has been procured, and it is proposed to try some experiments on the ratio of absorption under high pressures.

A "Lyman" wave-model has also been procured for illustrating the subject of wave-action.

IX. Some tests of service fuzes and of a new form of "machine-made" fuzes have been made. Some of the results are shown in Appendix E. One anomalous result observed was that some of the fuzes that had been on hand for several years gave a lower resistance when heated than when cold. On opening these fuzes globules of free mercury were found, apparently formed by the decomposition of the mercuric fulminate, though I have never seen it stated that such a decomposition is possible. The machine-made fuzes gave remarkably uniform results, and some suggestions were given for improving them in other respects, but the new lot has not been received.

X. *Sims Torpedo*.—As there is an allotment of \$5,000 for buying motors for some of the torpedoes furnished by Mr. Sims several years ago, and as he now claims to have made great improvements in his motor, a number of trials of this torpedo were made and others are proposed.

The new motor is adapted to a much higher speed than the old one, and the current required to drive it has a much higher E. M. F., in some cases reaching 1,300 volts. To provide for this the cable is much better insulated than the old ones, the wire being very fine and the dielectric being nearly pure rubber put on in strips wound round and round. It is then passed through melted paraffine and coated with dry cotton and finally with a braid of tarred hemp. The insulation seems to be excellent, and no instance of a leak in it has occurred, notwithstanding the high voltage and the fact that it has been wound and unwound ten or twelve times. It is doubtful whether this insulation would last long in store unless it was constantly submerged in water. The torpedo carries about one mile of this cable, but it is very little larger than the old cable.

The torpedo itself is smaller and the float is longer than the old one, while the model is intended to be better adapted to high speed. Plate III shows the form and dimensions of the torpedo complete.

The motor is geared to make two revolutions to one of the propeller, which is 30 inches in diameter and 30 inches pitch. A propeller with 36 inches pitch was tried in one run, but failed to give the speed attained with the 30-inch pitch.

The results of the trials with this torpedo show that it can far exceed

any results heretofore attained with it, the best speed with the old motor being about 10 miles per hour, while the new one gives over 18 miles.

After a preliminary dock-trial, the following runs were had for speed, viz:

June 3, 1889.—The torpedo started all right, but at moderate speed, and soon showed signs of a "short circuit." Steered to the left, and stopped at about 500 feet. On opening the torpedo, the coupling between the cable and the motor sections was found burned out. This was evidently caused by a slight leakage along the cotton cover of the cable which had not been removed.

June 7, 1889.—The steering-gear failed to work. Three starts were made, and she appeared to travel considerably faster than the old boats, but could not be guided, and failed to pass the second stake-boat. The rudder post was found to be considerably bent.

June 10, 1889.—The forward part of the rudder having been considerably reduced, a run of about 900 feet was made. The speed was good, and the steering successful, but one of the belts of the dynamo broke and the run was stopped. This was one of the old V-shaped belts, and the result showed that they were not strong enough to drive the large dynamo. They were at once replaced by a 12-inch flat belt, with larger pulleys, and it is not expected that any more trouble will arise from that source.

June 19, 1889.—The first successful run was had. The torpedo seemed to be under control, and made the distance of 2,510 feet in 110.2 seconds, giving a speed of 15.5 statute miles per hour. The course was marked by buoys and a flag was dropped at the instant the torpedo passed each buoy, the time being marked by a chronometer and a Morse register. The torpedo was also tracked and plotted by a party of officers under Lieutenant Wilson, but the transits worked badly and the results were submitted as approximate only. The run was at 3.30 p. m., an hour before high tide.

June 21, 1889.—Another run was made over the course, a third buoy having been placed 805 feet beyond the first, and 1,705 feet from the third buoy. The run was at 11.30 a. m., about one hour before low water. Time from first to third buoy 101 seconds, the distance being 2,510 feet and the speed 16.96 statute miles. From the second to the third buoy the speed was 17.4 statute miles per hour. The propeller turned with difficulty, and it was roughly estimated that about 5 horsepower would be wasted in friction. On the recovery of the boat it was found that the shaft turned still harder, and an examination showed that the bearings had become heated and required readjustment.

June 27, 1889.—The run was set for 10.30 a. m., but owing to certain breaks in the circuit it did not come off till 12 m., an hour and a half after high tide. The time was marked by Captain Roessler, on a Morse register, and by Lieutenant Wilson with a stop-watch. Lieutenant Lucas read Thomson's electrostatic voltmeter, and Sergeant Newman the Ayrton & Perry am-meter, No. 1067. Speed of the dynamo was taken by Lieutenant Taggart, and Sergeant Kennedy read Mr. Sims' voltmeter. The run was a good one, the time of the passage between the first and third buoys, by Captain Roessler and Lieutenant Wilson, being 98.4 seconds, giving an average speed of 17.4 miles per hour. Between the second and third buoys the speed was 18.2 statute miles per hour. The potential at the dynamo varied from 1,160 to 1,260 volts, and the current was from 34.5 to 38.5 amperes. Highest dynamo revolutions, 1,040 per minute.

This was the last run during the fiscal year, but the torpedo has since slightly improved the record by giving a speed of 19 miles per hour. Three instantaneous photographs, showing the torpedo under way, and the peculiar waves produced, are forwarded herewith, marked V¹, V², and V³.

XI. A series of experiments was made to test the reliability of a number of circuit-closers, but it was interrupted by the breaking down of the *Bushnell*. The results obtained were reported to the Chief of Engineers in January last, and as they were only preliminary to a more extended series it is not thought necessary to repeat them here.

STATEMENT OF FUNDS.

I. *Engineer depot at Willets Point, New York.*—Congress appropriated for the fiscal year ending June 30, 1889:

For incidental expenses of depot (incidentals).....	\$5,000.00
For instruction of battalion (materials).....	1,500.00
For purchase and repair of instruments (instruments).....	2,000.00
For purchase and binding of professional works of recent date on military and civil engineering (library).....	500.00
For rebuilding laboratory for enlisted men, which was destroyed by fire in November, 1886 (laboratory).....	6,500.00
For repairs of sea-wall and wharf at Willets Point, New York.....	2,500.00
Total	18,000.00

Of this there has been expended and pledged:

For incidental expenses of depot (incidentals).....	\$5,000.00
For instruction of battalion (materials).....	1,500.00
For purchase and repair of instruments (instruments).....	1,989.95
For purchase and binding of professional works of recent date on military and civil engineering (library).....	500.00
For rebuilding laboratory for enlisted men, which was destroyed by fire in November, 1886 (laboratory).....	6,500.00
For repairs of sea-wall and wharf at Willets Point, New York.....	2,500.00
Total	17,989.95

II. *Torpedoes for harbor defense.*—The expenditure of the following items of the \$200,000 appropriated by act of Congress September 22, 1888, has been placed in my charge, and is available until expended, viz:

1. For purchase of a complete electric-light outfit.....	\$10,000.00
2. For purchase of submarine mining material.....	58,000.00
3. For continuing torpedo experiments.....	15,000.00
4. For instruction of engineer troops in submarine mining.....	10,000.00
5. For purchase of motors for equipping movable torpedoes.....	5,000.00
Total	98,000.00

Of this there has been expended and pledged:

1. For purchase of a complete electric-light outfit.....	\$2,000.00
2. For purchase of submarine mining material.....	57,625.07
3. For continuing torpedo experiments.....	4,107.08
4. For instruction of engineer troops in submarine mining.....	4,217.78
5. For purchase of motors for equipping movable torpedoes.....	
Total	67,949.93

III. *New appropriations.*—Official notification has been received of the appropriation for the fiscal year ending June, 1890.

The following amounts have been assigned to me for disbursement,

contained in General Orders No. 26, Headquarters of the Army, Adjutant-General's Office, Washington, D. C., March 19, 1889, viz:

Engineer depot at Willets Point, N. Y.:

1. For incidental expenses of depot (incidentals).....	\$5,000.00
2. For instruction of battalion (materials).....	1,500.00
3. For purchase and repair of instruments (instruments)	4,000.00
4. For purchase and binding of professional works of recent date on military and civil engineering (library).....	500.00
5. For a new building containing engineer models	8,000.00
Total	19,000.00

Congress appropriated by act of March 2, 1889, under the general title "Torpedoes for harbor defense" the sum of \$250,000 for needful casemates and cable galleries to render it possible to operate submarine mines, and the money is available until expended.

The Board of Ordnance and Fortifications has approved an allotment from the above, based upon the estimates of the Board of Engineers, and the allotment has been authorized by the Acting Secretary of War as follows: For mining casemate and cable gallery at Willets Point, \$25,000. This amount was assigned to me for disbursement.

ESTIMATES.

There will be required for the fiscal year ending June 30, 1891, the following, viz:

I. For incidental expenses of depot, including fuel, lights, chemicals, stationery, hardware, extra-duty pay to soldiers necessarily employed as artificers, on work in addition to, and not strictly in the line of their military duties, such as carpenters, clerks, blacksmiths, draughtsmen, printers, bookbinders, lithographers, engine drivers, teamsters, wheelwrights, masons, painters, laborers, and clerk hire, and for materials to repair public buildings, machinery and unforeseen expenses.....	\$5,000
II. For purchase of materials for the instruction of engineer troops in their special duties of sappers and miners, for land and submarine mines, and pontoniers, torpedo drill, and signaling.....	1,500
III. For purchase and repair of instruments to be issued to officers of the Corps of Engineers and to acting engineer officers, for use on public work and surveys.....	2,500
IV. For the library of the United States Engineer School; purchase and binding of professional works of recent date, treating of military and civil engineering and kindred scientific subjects.....	500
Total	9,500

Very respectfully, your obedient servant,

W. R. KING,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

APPENDIX A.—PROGRAMME OF STUDY AND INSTRUCTION FOR WINTER SEASON.

[Printed Orders No. 231.]

UNITED STATES ENGINEER SCHOOL,
Post of Willets Point, New York Harbor, November 8, 1888.

The following programme of study and instructions for the ensuing winter season, commencing Monday, December 3, 1888, and ending Friday, April 27, 1889 (a period of twenty-one weeks), having been recommended by the academic staff and approved by the Chief of Engineers, will be carried into effect.

COURSE FOR OFFICERS.

1. Examinations by the academic staff will be held at the end of January and April, and intermediate examinations, as nearly monthly as practicable, will be held by committees of the academic staff. Marks at examinations will be on the West Point system, and the committees will report to the commandant of the school the results of the examinations. As the efficiency of the instruction can be much influenced by the instructors, they will keep themselves fully advised of the progress of the students; will give them at any time any needed aid, and when the information on special subjects is difficult to obtain, should supplement the course by lectures. The instructors will meet their classes weekly, and assign the lessons for the following week.

FIRST WINTER'S COURSE.

2. The course for engineer officers spending their first winter at the school will be Torpedoes, nineteen weeks; surveying, two weeks. For officers of other arms of the service detailed for special instruction in the torpedo service: Torpedoes, twenty-one weeks.

TORPEDOES.

3. (a) Text books and instructions, as follows: (1) So much of Abbot's Notes on Electricity as relates to electrical units, batteries, electrical measuring instruments, electrical measurements and magneto-exploders; supplemented by extensive laboratory practice in the solution of practical electrical problems. (2) Abbot's New Torpedo Manual. (3) So much of Part II, Professional Papers No. 23, Corps of Engineers as relates to the manipulation of the fish torpedo.

(b) Theoretical and practical instruction. (1) Incandescent electric lighting, as applied to the lighting of barracks, magazines, casemates, etc., in extensive systems of fortification. (2) The details of an electric search-light plant. (3) The problem of the electrical transmission of energy. Books of reference: Thomson's Dynamo Electric Machinery; Kapp's Electrical Transmission of Energy; Maier's Arc and Glow Lamps; Gray's Absolute Measurements.

(c) Attendance at the electrical laboratory will be regulated by the instructor. Theoretical study will be done as far as practicable in quarters, and after reasonable preliminary practice all electrical measurements must be made without the use of text books or diagrams. During the last two weeks of the winter's course each officer will prepare a plan (map and memoir) for the torpedo defense of Narragansett Bay and Newport, R. I., showing the location of the torpedoes, all junction boxes, cables, and casemates. The plan to include location, armament, and type of battery designed for the defense of the torpedo lines.

4. Surveying (last two weeks of course, and preparatory to actual field work): Such parts as may be designated by the academic staff, of Johnson's Theory and Practice of Surveying.

SECOND WINTER'S COURSE.

5. Civil engineering, five weeks; military engineering, seven weeks; photography, five weeks; torpedoes, four weeks.

CIVIL ENGINEERING.

6. Five weeks. Subjects: (1) Measurement of river discharge; (2) improvement of non-tidal rivers; (3) improvement of tidal rivers.

7. Text books: Vernon Harcourt's Rivers and Canals; Schlichting's Improvement of non-tidal Rivers. Books of reference (see third winter's course).

MILITARY ENGINEERING.

8. Seven weeks. Subjects: (1) Modern guns, carriages, and projectiles; (2) steel, compound, wrought, and cast iron armor; (3) modern ships of war and sea-coast defenses; (4) modern fortifications, and their attack and defense.

9. Text books: Such parts of the following books as may be designated by the academic staff: Woolwich Text Book of Fortifications, Maguire's Attack and Defense of Coast Fortifications; Fortifications of To-Day; Inglis' paper in Professional Papers Royal Engineers, 1884, and a lecture on armored defense in Ordnance Notes No. 151; Vary's Development of Armor; Naval Intelligence Papers, June, 1883; Adams' Spezia Experiments, 1886; Baylay's Types of Modern Guns; The Production of Heavy Guns for Coast Defense, Sir A. Clark.

10. Books of reference: Articles on Fortification and Gunnery, Encyclopædia Britannica; Ordnance Notes, No. 135 and Appendix; Volume 9, Professional Papers Royal Engineers; Report Board on Fortifications; Text Books on Gunnery, McKinlay; Naval Annual 1887, Brassay.

MILITARY PHOTOGRAPHY.

11. (Five weeks.) Practice will be had in the following methods: Negatives by wet and dry processes; developers and intensifiers; silver printing, and finishing and mounting of prints; map printing; photo lithography, including the negative and transfer to stone and printing. Each officer to submit twelve printed copies of his map. Text-books: Griffin's Notes on Photography.

TORPEDOES.

12. (Four weeks.) One or more officers of the second and third winter's course will be detailed weekly to report to the instructor in torpedoes, as assistant for testing core joints and instructing enlisted men on the torpedo detail.

THIRD WINTER'S COURSE.

13. Civil engineering, eight weeks; military engineering, eight weeks; torpedoes, five weeks.

CIVIL ENGINEERING.

14. (Eight weeks.) Subjects: (1) Wave and current action, and improvement of harbors; (2) canals; (3) steam engines and pumps.

15. Text-books: Such parts of the following text-books as may be designated by the academic staff: Vernon Harcourt's Rivers and Canals, and Harbors and Docks; Edward's Steam-Engines.

16. Books of reference: Rankine's Civil Engineering and Steam-Engine; Bixby's Pointe de Grave; articles on hydro-mechanics and steam-engine in Encyclopedia Britannica; Cotterill's Applied Mechanics; Jameison on Steam-Engine; Steam-Boilers, Wilson; Modern Steam-Engine, Rose; Canal and River Engineering, D. Stevenson; Construction of Harbors, T. Stevenson; Trautwine's Engineers' Pocket Book.

MILITARY ENGINEERING.

17. (Eight weeks.) Hamley's Operations of War, and preparation of project for the defense of such place as may be designated by the instructor.

TORPEDOES.

18. (Five weeks.) See paragraph on torpedoes in second winter's course.

COURSE FOR ENLISTED MEN.

INSTRUCTION OF ENLISTED MEN IN TORPEDOES.

19. Details will be for one week, and from the companies in turn, and will consist of 1 sergeant, 1 corporal, and 12 privates.

20. The details will spend the regular fatigue hours, Saturdays and Sundays excepted, at the old instruction building for enlisted men. Every soldier not excused by orders will be included on this list; but the roster will be arranged specially for the benefit of the recruits. Their instruction will be directed by the instructor in torpedoes, who will be assisted by the lieutenant detailed.

21. Instruction will comprise telegraphing with the dial instrument, including the code for action, and practice in the Morse system of telegraphy; the duties of the loading room, and, so far as practicable, of the boat service as prescribed in the torpedo manual, comprising preparing the plugs of the buoyant and ground torpedoes; charging the mines; charging the cut-off boxes, three methods: jointing the cores; making turk's heads in the electrical cable; using the junction boxes; attaching a cable stop; splicing and knotting hemp rope; inserting thimble in wire mooring rope. They will also receive from the instructor in torpedoes, or his assistant, lectures respecting the fuzes, explosives, torpedo material (except that of the operating room), voltaic batteries, simple electrical testing, and the use of the portable apparatus for the electrical ignition of mines. On Saturday the instructor in torpedoes will submit a report giving the names and proficiency of the detail, what verbal and other instructions they have received, and will give the insulation of the core joints made by them.

INSTRUCTION OF ENLISTED MEN IN PHOTOGRAPHY.

22. Two non-commissioned officers will be detailed each week for instruction in map printing.

23. The following assignment of instructors is made:

Military engineering: Capt. E. Maguire, Corps of Engineers.

Civil engineering: Capt. E. Bergland, Corps of Engineers.
 Torpedoes: Capt. S. W. Roessler, Corps of Engineers.
 Military photography: The battalion quartermaster.
 By order of Lieutenant-Colonel King:

J. G. WARREN,
First Lieut. of Engineers, Post Adjutant.

APPENDIX B.—PROGRAMME OF STUDY AND INSTRUCTION FOR SUMMER SEASON.

[Printed Orders No. 77.]

UNITED STATES ENGINEER SCHOOL,
Post of Willets Point, New York Harbor, April 22, 1889.

The following programme of study and instruction for the ensuing summer season, to commence May 6 and end November 16, 1889 (twenty-eight weeks), having been recommended by the academic staff and approved by the Chief of Engineers, will be carried into effect:

MILITARY ENGINEERING.

1st. Instruction by the company officers in the nomenclature, dimensions, and construction of modern siege batteries and saps. 2d. A full course of trestle and ponton drill. 3d. Instruction in military mining. 4th. Military map making in accordance with existing orders and instructions. Each lieutenant who has not already done so, and such non-commissioned officers and privates as may be selected from each company, will make satisfactory foot reconnaissances about 4 miles long in the vicinity of the post, the maps thereof to be submitted by company commanders to post headquarters on or before the termination of the season.

TORPEDO DRILLS.

After receiving such preliminary practice as may be necessary to acquaint them with the practical details of preparing and planting a torpedo, the officers of the torpedo class will be divided into details of at least two officers each, for the purpose of taking charge of the preparation and planting of a grand group of torpedoes. The senior officer will be in general charge, and will keep a daily journal of operations, noting particularly any difficulties encountered and any suggestions that may occur to him looking to the avoidance of similar difficulties in the future. The officers will frequently interchange duties so that each one shall have some experience in each part of the drill. The electric light will be set up and operated. The grand group being completed and the search light in position, the post commander will order an exhibition drill illustrating the operations of the torpedo defense against an attempted passage of the mine field by an enemy's vessel under cover of night. The group will then be taken up by the same detail and the parts dismantled, cleaned, and conveniently grouped for the inspection of the instructor. The detail will be instructed and exercised in automatic and judgment firing drills at such times as may be most convenient before the final exhibition drill.

If boat facilities can be provided, two grand group drills will be carried on at the same time.

The detail of enlisted men for each grand group drill will consist of 3 non-commissioned officers and about 12 privates. The hours of work will be from 7 to 11.30 a. m., and from 1 to 5 p. m. Both officers and enlisted men will be excused from all other military duties while actively engaged on this work. In bad weather, when no work is done and the men are in barracks, the latter will attend the same company duties and roll calls as daily duty men.

Weekly reports of progress will be rendered by the senior officer of the detail, and at the conclusion of the work each officer will submit a report of the work done by him, mentioning difficulties encountered and any suggestions he may desire to make. A detailed record will be kept of what each man does, with the view of tracing out the author of defective work and determining the degree of proficiency developed by individual members of the detail. An account of the character of work done by each man will be submitted by the senior officer with his final report. Upon completion of the drill such men of the detail as shall have shown themselves efficient and deserving will, if practicable, receive furloughs of two days.

Occasionally loaded mines will be planted and fired as in actual service, height of jet, effect on neighboring mines, and other phenomena being carefully observed and recorded.

Experiments will be made with the self-acting mine at such times as will not interfere with the grand group practice.

The details of officers will be made, as far as practicable, from the artillery and infantry officers until the 1st of July.

CIVIL ENGINEERING.

The following instrumental surveys will begin as soon as practicable, and officers when detailed for this purpose will be excused from all other duty *when actually engaged in the field-work*. Each lieutenant who has not already done so will make and plot a careful instrumental survey of about one square mile of ground. The work will include contours with a surveyor's level. He will be assisted in the field-work by details of non-commissioned officers and privates from his company. The work will be plotted on a scale of 12 inches to the mile, with contour planes 10 feet apart. Good level bench-marks should be made and located on the map, the references being given a column of notes. The names of the residents should be recorded. A field azimuth of one of the lines will be determined astronomically. The finished maps will be submitted on or before the termination of the season.

A careful hydrographic survey of about one-quarter of a square mile, including current measurements with electric current meter and double floats, will be made, if practicable, by the lieutenants who have not already done so.

FIELD ASTRONOMY.

All the lieutenants who have not already completed the course, and been excused from further observations, will constitute the observers, being called upon by the officer in charge as wanted. In addition, when officer of the day (except on Sundays), the weather permitting, they will observe the sun for time.

The following system will govern the observations at the observatory. The course covers two seasons—the first including sextant work, and transit and zenith telescope work, with the instruments in the east wing and on the outer pier; and the second including sextant work, practice with the new combined instruments in the west wing. Officers wishing to use the instruments for special observations or practice must apply for authority to do so.

Suitable blank forms will be provided both for observations and computations; and these original records after inspection by the commanding officer will be returned to the officers as their personal property.

The following allowance of time will be made for computations: Three days for a set of latitude observations with the sextant, for a set of time observations with the transit, for the value of a level division or for a micrometer turn with the zenith telescope, and ten days for latitude with the zenith telescope.

The following will be the ordinary routine of observations with the several instruments:

Sextant.—After becoming skillful in the use of this instrument upon the sun observers will deduce at least one satisfactory latitude by observing a north and a south star, using the time deduced from an east and a west star—each based on ten altitudes taken on the same night. These observations for latitude and time must be made at the observatory, and the time results must be reported for the Lukens' chronometer. *No other record will be accepted.*

Transit.—A satisfactory set of time observations will be taken by each officer on two nights, successive if possible, the observer taking his own time.

Zenith telescope.—Observers will first determine the level correction by daylight, using a distant terrestrial object, or at night using a slow circumpolar star. They will then find the value of a turn of the micrometer by observing Polaris at elongation. Lastly, they will observe for latitude until they have obtained a satisfactory determination based on three nights' work upon not less than twenty pairs.

Astronomical Azimuth.—Each officer serving his second year will determine an astronomical azimuth—using a large theodolite for the purpose.

Each officer shall receive instructions in the use of the personal equation machine and chronograph, and in comparison of chronometers.

MILITARY PHOTOGRAPHY.

The officers' laboratory will be open daily from 1.30 p. m. until 4 p. m. The building, apparatus, chemicals, etc., will be under the charge of the battalion quartermaster, whose duty it is to furnish any desired assistance, and who will be held responsible for the judicious use of the property. Officers are invited to avail themselves of the advantages of the laboratory, making such arrangements with the officer in charge as shall insure no confusion in his official duties, or in those of the men under his instruction. The instruction of enlisted men will be restricted to a weekly detail of one non-commissioned officer from each company. The battalion quartermaster will submit to this office weekly reports, showing the *nature of the instruction given*, the results attained and the progress made.

By order of Lieutenant-Colonel King:

J. G. WARREN,
First Lieut. of Engineers, Post Adjutant.

APPENDIX C.—ASSIGNMENTS TO CHARGE OF DEPARTMENTS OF INSTRUCTION.

[Printed Orders No. 81.]

UNITED STATES ENGINEER SCHOOL,
Post of Willets Point, New York Harbor, April 26, 1889.

I. The following assignments to the charge of Departments of Instruction, for the ensuing summer season, are announced:

Military Engineering, the captains in turn, excepting the instructor in torpedoes.
 Astronomy, Capt. R. L. Hoxie.
 Civil Engineering, Capt. Eric Bergland.
 Torpedoes, Capt. S. W. Roessler.
 Military Photography, First Lieut. George A. Zinn.

Each officer in charge of a Department will render to Post Headquarters weekly progress reports and in addition will, at the close of the season November 26, 1889, make a full report upon the season's work together with such suggestions as he may wish to make, especially with regard to possible improvements either in adopted methods of instruction or in the nature of the instruction given.

II. Such detailed instructions as may be necessary to carry out the provisions of Order No. 77, c. s. from this office and for the routine duty of the Post, will hereafter be published monthly.

III. Target practice, as prescribed in the "Small-Arms Firing Regulations," will begin on May 1, and be continued throughout the month, daily, except Saturdays and Sundays, during fatigue hours.

IV. Dress parades will be resumed on May 1. First call will be sounded at 6.30 p. m.

V. The following are excused from dress parades: The police sergeant, provost sergeant, torpedo, depot, and photographic sergeants; 1 telegraph operator; Post bakers; mail carrier; 1 stable orderly; crew of *Karitan*; 2 cooks and 1 barrack orderly from each company.

The following from Sunday morning inspection: The police sergeant; Post bakers; driver of ice cart; mail carrier; 1 stable orderly; 1 telegraph operator; 2 cooks and 1 barrack orderly in each company.

VI. On and after the 30th instant, all formations under arms will be in full dress, without blanket bags, canteens, or haversacks.

VII. Beginning May 1, calls will be sounded as follows: Reveille, 5 a. m.; breakfast, 5.30 a. m.; sick call, 6.15 a. m.; fatigue, 6.30 a. m.; guard-mounting, 8 a. m.; Sunday morning inspection, 8 a. m.; recall from fatigue, 11.30 a. m.; dinner, 12 m.; fatigue, 1 p. m.; recall from fatigue, 4 p. m.; dress parade, 6.30 p. m.; tattoo, 9 p. m.; taps, 9.30 p. m.

By order of Lieutenant-Colonel King:

J. G. WARREN,
First Lieut. of Engineers, Post Adjutant.

APPENDIX D.—ORDER CONVENING BOARD OF OFFICERS TO EXAMINE AND REPORT UPON TORPEDO MATERIAL.

[Extract.]

Orders No. 72]

UNITED STATES ENGINEER SCHOOL,
Post of Willets Point, New York Harbor, April 17, 1889.

III. A Board of Officers will convene at the Officers' Laboratory at 10 o'clock a. m. to-morrow, or as soon thereafter as practicable, to examine and report upon the following torpedo material, viz: (1) Two forms of mooring shackles. (2) A new mooring rope. (3) A bronze torpedo case. (4) Two experimental cut-off boxes. (5) An operating box. (6) A core-jointer. (7) A system of firing without the automatic switching on of the firing battery.

DETAIL FOR THE BOARD.

Capt. Eric Bergland, Corps of Engineers; Capt. S. W. Roessler, Corps of Engineers; First Lieut. G. A. Zinn, Corps of Engineers; First Lieut. H. C. Newcomer, Corps of Engineers; Second Lieut. M. M. Patrick, Corps of Engineers; Second Lieut. F. R. Shunk, Corps of Engineers; Second Lieut. H. Jervey. The junior member will act as recorder.

The Board will avail itself of all accessible information and make such investigation as may be deemed necessary to enable it to report.

- (1) As to the necessity or desirability of each proposed improvement.
 - (2) What advantages, if any, would the proposed apparatus possess.
 - (3) Are any modifications or additions to it desirable.
 - (4) What experiments, if any, are desirable to establish doubtful points that may arise.
 - (5) Any further suggestions on the subject that may occur to the Board.
- The report should be as full and specific in all respects as circumstances will permit, and should be completed as soon as practicable. If any question is likely to consume too much time, it may be set aside and reported on separately.
- By order of Lieutenant-Colonel King:

J. G. WARREN,
First Lieut. of Engineers, Adjutant.

MEMORANDUM FOR BOARD ON TORPEDO MATERIALS.

UNITED STATES ENGINEER SCHOOL,
Post of Willets Point, New York Harbor, April 17, 1889.

Some of the appliances submitted to the Board are not in as complete order for trial or inspection as could be wished. In fact they are hardly in presentable form; but it is thought that they will be readily understood, and that the Board will be able to supply the missing details, and suggest improvements or experiments that will lead to them.

(1) Would the proposed mooring-shackles dispense with the thimble and clevy; and, if so, how much time and expense would be saved? Would the fastening be secure against great strains or long-continued oscillations? Would it enable us to use a mooring rope of a coarser wire; and, if so, would this add to its durability against corrosion and twisting off? (Both shackles have been tested by a tensile strain of 5 tons or 11,000 pounds.)

(2) Would a mooring-rope with interlocked wires laid on in opposite twists be more durable, and would its rigidity in connection with the use of the proposed shackles tend to check the twisting motion of the torpedo, and thus save the insulated cable? Would the additional cost be justified?

(3) Would a bronzed torpedo-case cast in one piece be strong enough to stand the various strains likely to come upon it? What experiments are desirable to test this matter? Would such a case be less liable to corrosion in storage or possess any other advantage over steel; and, if so, how much more would they be worth to the Government?

(4) Would it be practicable by means of either of the proposed cut-off boxes to dispense with the four core-joints outside each cut-off box, and short pieces of cable now required? What time would be saved in the loading room and in planting? Would the proposed methods of securing the ends of the cable without using the clamps in the triple junction-box be feasible? Would the proposed methods of securing the fuzes and packing the joints be effective?

(5) Would the proposed methods of grouping the disjuncter, resistance coil, firing and testing keys, etc., be advisable? Would it simplify the operating box and dispense with one form of box?

(6) Would the McIntire core-jointer be an addition to the service outfit? How would its cost and efficiency compare with the oval brass tube jointer?

(7) Would it be practicable to dispense entirely with the purely automatic firing switch, and depend on the operator to fire any torpedo that might be struck? Would this take too much time? To what extent would it simplify the operating box? Would it make the signal and firing apparatus much safer against accident to itself or to some friendly vessel, picket boat, or one of our own ships that might be driven in by the enemy, for example? Would it avoid the necessity of disjuncter in the casemate?

By order of Lieutenant-Colonel King.

J. G. WARREN,
First Lieutenant of Engineers, Adjutant.

REPORT OF BOARD.

WILLETS POINT, NEW YORK HARBOR, *April 17, 1889.*

The Board, pursuant to the foregoing order, assembled at the officer's laboratory at 10.30 a. m.

Present, all the members.

The order convening the Board and the memoranda submitted were read. In order to facilitate the investigations called for it was decided to divide the Board into committees, to be appointed by the president. They were appointed as follows, di-

rected to investigate their respective subjects, and to inform the recorder when in readiness to submit their reports:

- | | |
|---|------------------------|
| (1) Two forms of mooring shackles..... | Lieutenant Zinn. |
| (2) A new mooring rope..... | Lieutenant Newcomer. |
| (3) A bronze torpedo case..... | { Captain Bergland. |
| | { Captain Roessler. |
| (4) Two experimental cut-off boxes..... | { Lieutenant Newcomer. |
| | { Lieutenant Shunk. |
| (5) An operating box..... } | { Lieutenant Patrick. |
| (7) A new system of firing } | { Lieutenant Shunk. |
| | { Lieutenant Jervcy. |
| (6) A core-jointer..... | Captain Roessler. |

REPORT OF COMMITTEE ON SHACKLES AND MOORING ROPE.

The committee on shackles and mooring rope makes the following report:

(1) The two shackles proposed were examined. Shackle No. 1 is the invention of Colonel King; No. 2 of Lieutenant Gillette. The use of No. 1 would dispense with the thimble. The old shackle has four parts, while No. 1 has but three. Simplicity in material is thus gained, but in the opinion of the committee the cost of manufacture of No. 1 would most probably exceed that of the old form. It is believed that there would be a gain of time in preparing the mooring rope with No. 1, but further experiments are necessary to determine the amount of this gain.

With the use of lead in place of the wedges, as suggested by Sergeant Seymore, much time would be gained by the use of No. 1. This would necessitate the introduction of a small furnace into the torpedo material, and would dispense entirely with the riggers' vise. Lead was used with one shackle, and it was tested with a pull of 4½ tons. This strain caused the rope to start for about half an inch, but it did not pull out of the shackle. It is thought that the fastening with lead is more simple and certain to be securely made than with wedges, which require more care in adjusting. No. 1 has been tested with a strain of 11,000 pounds, but the committee is undecided as to the effect of long-continued oscillation. The change of shackle would apparently neither add to nor detract from the durability of the wire mooring rope.

Shackle No. 2 has as many parts as the old shackle. It will probably cost more on account of its shape and weight of metal. With an alteration in the riggers' vise, making it larger and of a different design, considerable time would be saved in preparing the mooring rope by use of No. 2. This shackle has been tested with a strain of 11,000 pounds, but should be further tested to determine the effect of long-continued oscillation. The committee would recommend that both the proposed shackles be made larger to facilitate passing the wire mooring rope through them, and that further tests be made with both forms to determine the effect of this change on the security of the fastening, and to determine the durability of both forms when used in water. It is probable that an important saving of time, with equal durability, may be obtained with one of the proposed forms.

(2) It is believed that the "patent locked wire rope" would be more durable than the wire rope used at present, and that by its rigidity it would tend to check rotation of the torpedo. The new shackles would have the same tendency. This is of some importance on account of the liability of the torpedo to being struck by friendly vessels. It would be necessary, however, to test the rope to determine definitely whether, and to what extent, it is superior to the old form in this respect. It is claimed that "there is no question as to its great durability against corrosion in salt water, as not only are all the wires galvanized, but the outer locked wire covering is almost water-tight, and affords perfect protection to the wires inside. If before immersing the rope is thoroughly well coated with a mixture of tar and oil it really becomes water-tight." This is an important advantage and would neutralize some additional cost in the wire rope. The steel wire mooring rope used at present cost 14 cents per foot in 1884. The patent locked wire rope of the same diameter (three-quarters of an inch) would cost about 22 cents per foot. The committee, however, believes the half-inch patent locked wire rope (steel) would have sufficient strength and durability, while its cost would be less probably than that of the mooring rope used at present. The half-inch rope also has the advantage of being lighter and opposing less resistance to currents. To determine the advantages of this form of wire rope, both as to ease of working and durability, the committee recommends the purchase of a quantity of the half-inch rope for experiment. A letter and circular from the Trenton Iron Company describing the rope are appended hereto.

GEO. A. ZINN,
First Lieutenant of Engineers.
H. C. NEWCOMER,
First Lieutenant of Engineers.

LETTER OF MR. E. GYBBON SPILSBURY, MANAGING DIRECTOR OF THE TRENTON IRON COMPANY.

THE TRENTON IRON COMPANY,
Trenton, N. J., March 16, 1889.

DEAR SIR: Replying to your favor of the 13th instant, forwarded from our New York office, we send you to-day our circular * giving strengths and weights of our "patent locked wire ropes;" we also send you a sample of our $\frac{3}{4}$ -inch galvanized steel rope, which we presume is just what you would require. The price of this rope is 18 cents per pound delivered. There is no question as to its great durability against corrosion in salt water, as not only are all the wires galvanized, but, as you will see, the outer locked wire covering is almost water-tight and affords perfect protection to the inside wires. If before immersing the rope is thoroughly well coated with a mixture of tar and oil it really becomes water-tight.

In proof of all this I would say that two and one-half years ago a mile section of this kind of rope was immersed in the river Rhone for towage purposes, to replace the ordinary chain there used. After eighteen months' service it proved so satisfactory that it was decided to add 7 miles more. When the end of the rope was raised to have the new section spliced on it was found, to the surprise of every one, that the inside wires were not even rusty, but still remained almost as bright as those in the new rope. From the manner in which these ropes are made, all tendency to twist is done away with, as the layers are each twisted in a different way, and so the twisting movements of all the wires are in perfect equilibrium.

We shall be pleased to furnish you every facility for testing these ropes you may desire, on points you raise, and hoping to receive your orders, we remain,

Yours truly,

TRENTON IRON COMPANY,
E. GYBBON SPILSBURY,
Managing Director.

Lieut. Col. W. R. KING,
U. S. Engineer Depot at Willets Point, Whitestone, N. Y.

REPORT OF COMMITTEE ON BRONZE TORPEDO CASE.

This sample torpedo case was manufactured by the Henry Bonard Bronze Company, New York, out of their ordinary statutory bronze metal. The case, including lowering ring, bosses for the support of the cap bolts, and reinforce adjacent to the annular plug, was made one solid casting, thus dispensing with the welded seam which exists in the forged steel or iron torpedo case. The diameter of the case is 32 inches, and its weight 256 pounds. It is identical in form with the approved steel torpedo case, except in two particulars, viz, it has no rim around the equator, and the lowering ring is countersunk, so that it projects but slightly above the bounding surface of the sphere.

From the preponderance of weight on one side it was evident that the thickness of the metal was not uniform, but the degree of variation in this particular the committee had no means of determining. So far as could be observed there were no abrupt changes in thickness of metal. The only other apparent defect in the casting was a flattening at one point near the equator, which was probably a hole or flaw in the original casting afterwards filled in. The hydraulic pressure test showed several pin-hole leaks, which however were closed by a light tapping of a hammer so as to stand a pressure of 200 pounds per square inch without appreciable leakage. A pressure of 300 pounds per square inch was applied without injury to the case.

To enable the committee to answer the question whether the case is strong enough to stand the various strains likely to come upon it, it is recommended that it be subjected to the action of a neighboring explosion at different distances, commencing at a distance of 80 feet from the exploding charge, then decreasing this distance by 20 feet for each succeeding experiment, until the case is ruptured, and in order to obtain a direct comparative test of strength between it and the approved steel case, it would be advantageous to place one of the latter as close to it as possible and at the same distance from the exploding charge. The bronze torpedo case, if it can be shown to possess the requisite strength to resist a neighboring explosion at a reasonable distance, and can be cast with a sufficiently uniform thickness of metal, would, it is believed, possess the advantages over the steel torpedo case of being less liable to corrosion in store and in water, and of being less easy to grapple. The mountings of a bronze torpedo should of course be of the same metal, to prevent the local action which takes place when two dissimilar metals are in contact with salt-water.

For the committee:

S. W. ROESSLER,
Captain of Engineers, Recorder.
Captain BERGLAND,
Captain ROESSLER,
Committee.

REPORT OF COMMITTEE ON CUT-OFF BOXES.

WILLETS POINT, NEW YORK HARBOR, *May 18, 1889.*

SIR: The undersigned have the honor to submit the following report on the merits of the two experimental cut-off boxes:

The second form of box proposed appears to be an improved form of the first, and need alone be considered.

(1) As to the necessity or desirability of the proposed change: It would be desirable to dispense with the four core-joints outside of the box. If this were feasible, and other things being equal, a more easily loaded box would be better. These changes are not, however, necessary.

(2) Apart from the core-joints, the proposed form would probably take less time to load than the present form, the indicated connections being simple and easily made. As regards dispensing with the joints, it is considered doubtful whether a water-tight packing can be made with the cable-wire insulation.

If it be possible to connect the cut-offs directly with the cable-wire, it will be more conveniently done in the contemplated form than in the present, but in the latter it is possible. The proposed form is more complicated in construction than the one now in use, which has the merit of great simplicity.

(3) No desirable additions or modifications have occurred to the committee.

(4) The new cut-off box should be used in planting a grand group of mines, the time required for loading and connecting carefully noted, and also the comparative ease of manipulation. To properly test the merits of the box it should be submerged for some time. In case it be found possible to dispense with the core-joints, the present form of box should be loaded in like manner, substituting the cable-wires themselves for the H and K wires, and the observation should be made.

(5) The boxes submitted to the committee did not appear to be finished, the interior connections, binding posts, etc., being only indicated. It is suggested that a complete box be furnished for testing purposes.

The proposed method of securing the ends of the cable is believed to be feasible, if it should be necessary, for instance, to use material on hand for the new form of box. It is considered, however, inferior to the method with clamps. This should also be tested in actual practice, when any advantages or disadvantages would become manifest.

H. C. NEWCOMER,
First Lieut. of Engineers.
FRANCIS R. SHUNK,
Second Lieut. of Engineers.

THE PRESIDENT OF THE BOARD ON TORPEDO MATERIAL.

REPORT OF COMMITTEE ON AN OPERATING BOX AND ON A SYSTEM OF FIRING WITHOUT THE AUTOMATIC SWITCHING ON OF THE FIRING BATTERY.

WILLETS POINT, NEW YORK HARBOR, *May 13, 1889.*

SIR: The committee appointed to investigate the subjects marked 5 and 7 in Post Orders, No. 72, convening this Board, have the honor to submit the following report:

5. *An operating box.*

(1) While the proposed improvement is not regarded as absolutely necessary, it is believed that the adoption of the new form is desirable.

(2) The new method of grouping the various parts of the system is simpler than the old and quite as efficient; all parts can be easily inspected and manipulated; it is an advantage to have the whole of the operating apparatus in a box which can be closed and locked; one form of box is dispensed with, and there are only nine wire connections as compared with fourteen in the old form. The old operating box can still be used for skirmish lines or for six groups of mines. The change can be made with but little expense, as it is intended to make use of material on hand.

(3) As to desirable modifications, the present reversing key is defective, but it is merely an improvised form, and can be readily improved. A key has been designed which will probably be more satisfactory. Another modification has been suggested, and will be an advantage, viz, a break in the firing circuit kept under lock and key.

(4) The new form of box should be used in all the electrical operations incidental to the planting and firing of one or more grand groups of submarine mines and any defects on its practical working ascertained.

(5) In regard to the new method of grouping, firing, and signal apparatus in a single box, the Board consider the following additional change desirable, viz, that the Bradley galvanometer used in testing be placed on the table near the operating box, so that it may be within easy reach of the operator.

7. *A system of firing without the automatic switching on of the firing battery.*

(1) The proposed improvement is not necessary, and we do not think it desirable, for emergencies might arise in which the automatic switching on of the firing battery could do very effective service.

(2) The change under consideration would certainly simplify the operating box. The apparatus could be reduced to a mere shutter or like contrivance to indicate the mine struck, and a k-y by which the operator could then switch on the firing battery. It is estimated that the operator, if on hand, would require at the most two seconds to move the key, so the time between impact and explosion would not be too long.

In the proposed system there would be less danger of injury to the signal and firing apparatus, as the mercury cups, whose faulty adjustment is the principal source of such danger, would be dispensed with.

(3) It is the opinion of the committee that the new system would not diminish the chances of accident to a friendly vessel, for, as in the present system, the firing switch is open unless likely to be used, and, except in case of gross carelessness of the operator, the only cause of disaster would be ignorance of the true character of the vessel striking the mine, and this would be equally disastrous in the two systems. A careless operator could find equal opportunities in the two systems of making a blunder. For safety it would be advisable to retain the disjunctur in the system.

(4) The only conclusive test of the relative value of the two systems would be their employment in war and a comparison made from the information there obtained.

Very respectfully, your obedient servants,

MASON M. PATRICK,
Second Lieut. of Engineers.
FRANCIS R. SHUNK,
Second Lieut. of Engineers.
HENRY JERVEY,
Second Lieut. of Engineers

The PRESIDENT OF THE BOARD.

REPORT OF COMMITTEE ON M'INTIRE JOINTER.

The jointer consists of two hollow copper cylinders of the desired length and interior diameter, placed parallel to each other and broised together. The wires enter the jointer from opposite directions, and a firm contact is made between the wires and the jointer by crimping or choking the latter at short intervals with a special form of pliers. The joint is strong and easily made, and is a great improvement over the one now used. The adoption of the McIntire jointer is recommended, its length to be the same as that of the oval brass tube jointer now in use.

S. W. ROESSLER,
Captain of Engineers.

WILLETS POINT, NEW YORK HARBOR.

The Board, having no further business to transact, adjourned *sine die*.
Respectfully submitted.

ERIC BERGLAND,
Captain of Engineers.
S. W. ROESSLER,
Captain of Engineers.
GEORGE A. ZINN,
First Lieut. of Engineers.
H. C. NEWCOMER,
First Lieut. of Engineers.
MASON M. PATRICK,
Second Lieut. of Engineers.
FRANCIS R. SHUNK,
Second Lieut. of Engineers.
HENRY JERVEY,
Second Lieut. of Engineers.

APPENDIX E.—REPORT OF LIEUTENANT CHARLES S. RICHÉ, CORPS OF ENGINEERS.

WILLETS POINT, NEW YORK HARBOR, March 22, 1889.

SIR: The following table sufficiently explains itself. In addition to the fuzes whose tests are given in the table, a number of fuzes, from 5 to 10 of the same batch, were opened and the priming examined for free mercury. Pouring the priming on a

piece of white paper and mixing it thoroughly, globules of mercury could be distinguished in every case without the aid of a lens, and with the lens numerous small globules could also be seen. Fuzes 1, 14, 16, 17, 33, and 38, all having a high resistance cold diminished in resistance when heated. The resistance in each case seemed to vary, increasing and decreasing, but principally decreasing, until the fuze exploded. These fuzes belong to one of these two batches, Sergeant Kelly is unable to tell which:

December 1, 1879, Goodyear 5,000 platinum fuzes (service cut off), at 6 cents. Between 1880 and 1886, Goodyear 5,150 platinum fuzes (wooden), at 6 cents.

They were issued by Sergeant Kelly to Sergeant Seymour about two weeks ago.

Tests of fuzes.

No. of fuze tested.	Resistance, cold.	Resistance, hot.	Current at explosion.	No. of fuze tested.	Resistance, cold.	Resistance, hot.	Current at explosion.
	<i>Ohms.</i>	<i>Ohms.</i>	<i>Amperes.</i>		<i>Ohms.</i>	<i>Ohms.</i>	<i>Amperes.</i>
1.....	1.230	1.187	.5529	27.....	.724	.793	.5247
2.....	.642	.702	.5247	28.....	.663	.727	.5529
3.....	.702	.790	.5387	29.....	.711	.775	.4130
4.....	.718	.819	.5247	30.....	.675	.738	.5529
5.....	.609	.702	.5529	31.....	.699	.771	.5811
6.....	.686	.787	.5529	32.....	.600	.660	.6097
7.....	.657	.754	.5811	33.....	2.005	1.388	.5529
8.....	.672	.744	.5247	34.....	.733	.799	.5247
9.....	.690	.787	.5529	35.....	.666	.736	.5529
10.....	.711	.803	.5247	36.....	.648	.721	.5529
11.....	.658	.705	.5811	37.....	.621	.669	.5529
12.....	.698	.796	.5529	38.....	2.325	1.286	.5811
13.....	.689	.767	.6097	39.....	.748	.807	.5811
14.....	2.126	1.483	.5247	40.....	.699	.763	.5529
15.....	.672	.744	.5811	41.....	.711	.787	.5529
16.....	4.03	1.296	.5529	42.....	.609	.783	.5529
17.....	2.510	1.400	.5247	43.....	.752	.830	.5529
18.....	.624	.724	.4688	44.....	.733	.815	.5811
19.....	.730	.811	.5529	45.....	.696	.771	.5529
20.....	.793	.803	.5811	46.....	.568	.657	.5811
21.....	1.187	1.281	.5529	47.....	.711	.790	.5529
22.....	.639	.696	.5811	48.....	.648	.718	.5811
23.....	.718	.783	.5811	49.....	.699	.757	.5529
24.....	.702	.771	.5529	50.....	.724	.793	.5811
25.....	.733	.808	.5529	51.....	.689	.760	.5529
26.....	.651	.721	.5529				

Respectfully submitted.

CHARLES S. RICHÉ,
Second Lieutenant, Engineers.

The POST ADJUTANT,
Through Instructor in Submarine Mining.

REPORT OF CAPTAIN S. W. ROESSLER, CORPS OF ENGINEERS.

WILLETS POINT, NEW YORK HARBOR, April 18, 1880.

SIR: The following are the results of the tests of three sample lots of fuzes furnished by H. Julius Smith, Pompton, N. J. The fuzes were identical in construction and differed only in the amount of the priming charge:

First sample, 6 fuzes, contained 1 grain fulminate of mercury.

Second sample, 6 fuzes, contained 2 grains fulminate of mercury.

Third sample, 6 fuzes, contained 4 grains fulminate of mercury.

The construction of the fuze is briefly as follows: The fuze wires are of the same length, 7 inches long, and consist of No. 22 B. W. G. copper wire, insulated with a single wrapping of cotton, impregnated with a preparation of coal tar. They are held together in the fuze by a double metal clamp, $\frac{1}{4}$ inch in width and $\frac{1}{4}$ inch long, having two parallel grooves in which the wires are clamped. The bridge end of the wires project about $\frac{1}{4}$ inch beyond the clamp. The clamp is imbedded in a sulphur composition contained in a thin paper cylinder, $\frac{1}{4}$ inch in exterior diameter and a little over 1 inch long. The bridge wire, which was furnished by the engineer depot at Willets Point, was the standard platinum wire, .0025 inch in diameter. As specified in the order to Mr. Smith, the length of the bridge was to be $\frac{1}{4}$ inch. The upper end of the fuze case or cylinder was closed by sulphur composition. The paper cylinder was covered by a black water-proof composition.

The resistances of the fuzes cold, and at the instant at explosion, and the currents required to explode, are given in the following table:

Number of fuze.	Resistance cold.			Resistance to explosion.			Current required to explode.		
	One-grain fuze.	Two-grain fuze.	Four-grain fuze.	One-grain fuze.	Two-grain fuze.	Four-grain fuze.	One-grain fuze.	Two-grain fuze.	Four-grain fuze.
	Ohms.	Ohms.	Ohms.	Ohms.	Ohms.	Ohms.	Amperes.	Amperes.	Amperes.
1.....	.68	.40	.63	.76	.72	.70	.55	.55	.55
2.....	.49	.61	.62	.64	.75	.72	.57	.50	.52
3.....	.57	.58	.63	.67	.74	.78	.55	.55	.55
4.....	.52	.54	.70	.68	.71	.82	.55	.55	.52
5.....	.57	.56	.67	.69	.71	.77	.55	.52	.55
6.....	.53	.50	.65	.69	.71	.74	.55	.55	.52
Mean.....	.56	.55	.63	.68	.72	.75	.55	.54	.54

The grand mean of resistance cold is .58 ohms. The grand mean of resistance hot is .72 ohms. The grand mean of current at explosion is .54 amperes.

The corresponding figures for the fuze heretofore used are given on page 81 of the manual, as follows: Resistance, cold, .7 ohms; resistance hot, .8 ohms; current at explosion, .48 amperes.

It is thus seen that the resistances of Mr. Smith's fuzes, both cold and hot, are less than those of the fuzes heretofore used, and the currents required to explode are greater. If the bridge wire was adjusted to the proper length I can find no satisfactory explanation for the former. The greater current for explosion may perhaps be due to a greater heat conductivity in the parts surrounding the bridge wire, whereby the heat is more rapidly conducted away and a correspondingly stronger current is required to bring the bridge to the proper temperature.

The amount of charge, as well as could be judged by the violence of the explosion, was uniform for each day. The upper part of the paper case is the only part demolished by the explosion, the lower half, that containing the clamp, remaining practically intact, even with the four-grain fuze, in this respect differing materially from the wooden plug fuze which is shattered into small fragments. The ends of the wires holding the bridge are bent outward, and in one instance where the fuze was contained in a piece of core-joint tubing, and exploded in a chamber of a mine switch, one of the wires nearly perforated the tubing, thus showing that there was some danger of contact being made in this way between the wire and the side of the chamber. It was thought that there was danger of the insulation of the wires where they enter the metal clamp becoming injured by the explosion, thus making a short circuit between wires and clamp, but no weakness of this character was developed.

The following alterations in the samples are suggested:

(1) That the wires, where they project beyond the clamp to form the bridge, be made as short as possible, shorter than they were in the sample, so that when they are bent outward by the force of the explosion there will be less danger of a short circuit by their being driven through the rubber tube and against the wall of the chamber.

(2) That a braided insulation, or at least a double wrapping of cotton, be used to insulate the wires, the single wrapping being liable to open at any point and expose the bare copper. This defect in the sample submitted was brought out in an attempt to load a few of the fuzes in the mine switch to be fired under service conditions.

Very respectfully,

S. W. ROESSLER,
Captain of Engineers.

The POST ADJUTANT.



PRESSURE GAUGE

— for —

Submarine Explosions.

W. R. KING.

Lt. Col. Eng^s.

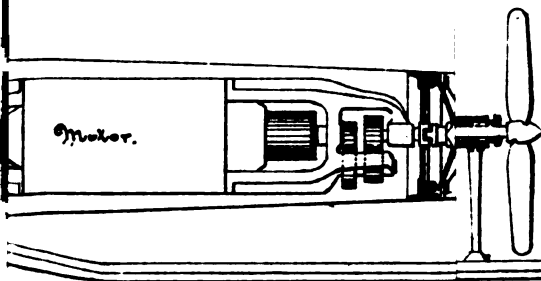
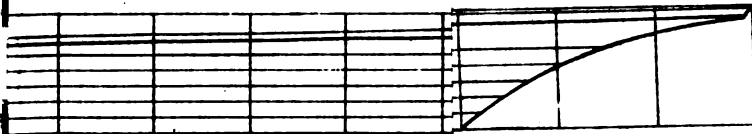


News.

Water Surfaces.

ISH TORPEI

2 X 3 FooX.



King
Lt. Colonel of Eng'rs. U. S. A.

EXPERIMENTS AT WILLETS POINT, N. Y.

PLATE IV. 1.









EXPLOSION IN AIR AT NIGHT, JULY 19TH, 1888.

Charge, 1 oz. dynamite.

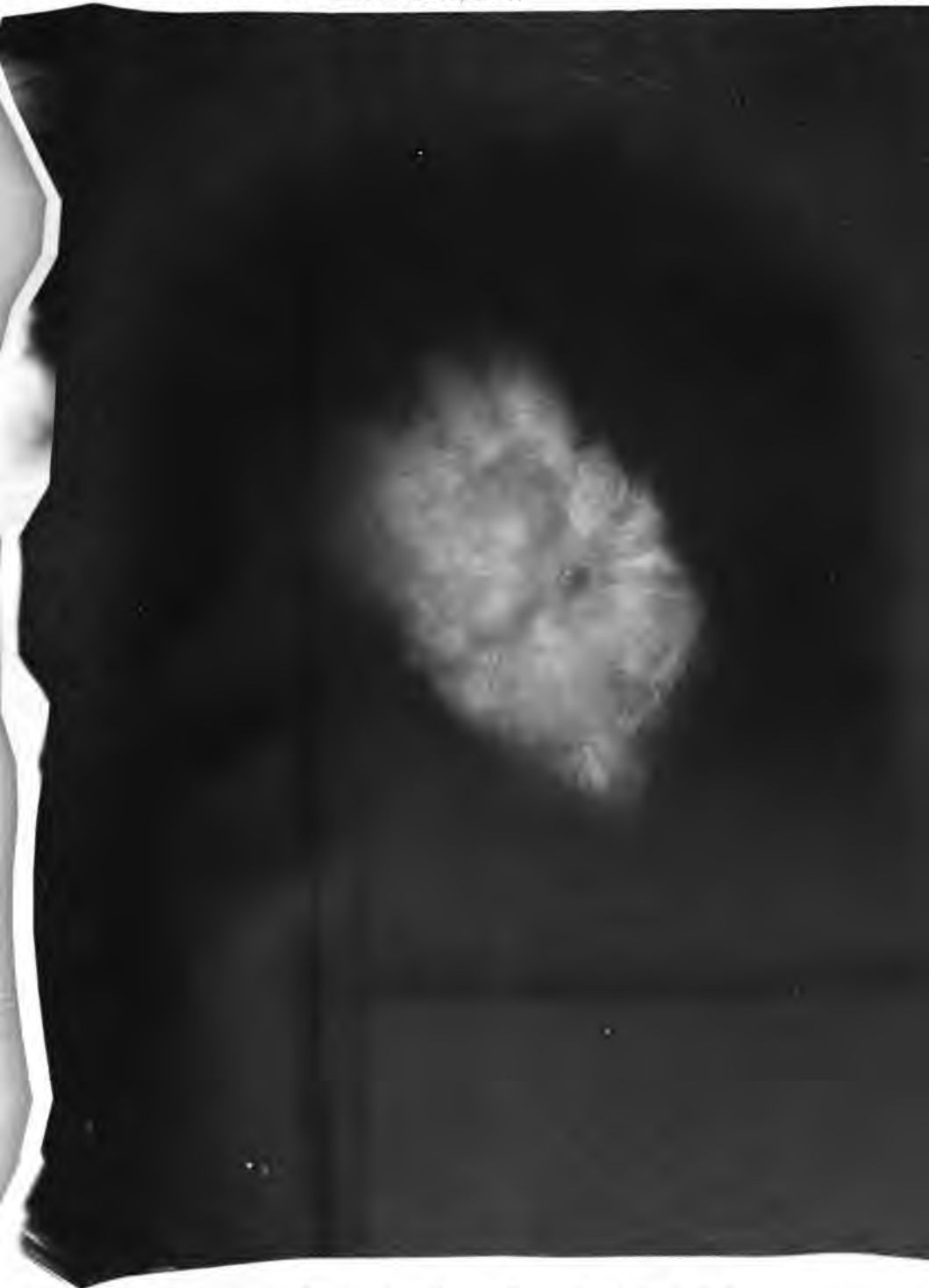


EXPLOSION IN AIR AT NIGHT, JULY 10TH, 1888.

Charge, 1 oz. dynamite and 20 grs. magnesium.



EXPLOSION IN AIR AT NIGHT, JULY 19TH, 1888.
Charge, 2 oz. mortar powder and 20 grs. magnesium.



EXPLOSION IN AIR AT NIGHT, JULY 19TH, 1888.

Charge, 2 oz. mortar powder.

EXPERIM

PLATE V. 1.



N. Y. Eng. & Ptg.





APPENDIX No. 4.

REPORT OF A BOARD OF ENGINEERS ON THE PATRICK "AUTO-MOBILE CONTROLLABLE TORPEDO."

ENGINEER SCHOOL OF APPLICATION, U. S. ARMY,
Post of Willets Point, Whitestone, N. Y., August 15, 1888.

GENERAL: I have the honor to transmit herewith the report of a Board of Engineers convened to report on the Patrick torpedo at College Point.

The papers sent to the Board are herewith returned.

Very respectfully, your obedient servant,

W. R. KING,
Major of Engineers, commanding.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF A BOARD OF ENGINEERS.

A report was made by a Board of Engineers convened by the following order, viz:

SPECIAL ORDERS, }
No. 31. }

HEADQUARTERS CORPS OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., June 25, 1888.

By authority of the Secretary of War, a Board of Officers of the Corps of Engineers, U. S. Army, consisting of Maj. William R. King, Capt. Edward Maguire, Capt. Solomon W. Roesler, First Lieut. Irving Hale, is constituted to meet at College Point, Long Island, on June 27, 1888, to witness a test of the "Auto-Mobile Controllable Torpedo" of Mr. J. N. H. Patrick.

The Board will submit a report as to the result of the trial, and its opinion as to the merits of the torpedo.

If, in the opinion of the Board, further tests are desirable, it is authorized to arrange with Mr. Patrick to that effect; said tests to be at Mr. Patrick's expense.

By command of Brigadier-General Duane:

CLINTON B. SEARS,
Captain of Engineers, U. S. A.

On receipt of this order it was arranged for Mr. Patrick to notify the Board whenever he was ready for a trial of the torpedo, and, in pursuance of this arrangement, the Board visited College Point, and witnessed a trial for speed on the 30th of June. Two members of the Board witnessed another speed-run on the 10th, and again on the 13th and 20th of July. Two members witnessed the process of making the gas and charging the tank on the 11th of July.

The torpedo undergoing the trial was built for the French Government, and the tests were made with a view to its acceptance by the agent of that Government.

It belongs to the class of "self-moving," controllable torpedoes, and is a development of the Lay torpedo, which began to assume a practicable form some sixteen years ago, and, after improvement by Mr. Haight about 1881, became by still further improvement the "Patrick" torpedo of the present form. A similar torpedo, but of somewhat smaller dimensions, was tested and reported on in 1886 by the Board of Engineers of which General Duane was president, and described by Lieutenant Schroeder, U. S. Navy, in papers on "Recent Naval Progress for 1887."

The torpedo and its float are cylindrical in form, with conoidal ends, the former being 42 feet long and 24 inches in diameter, while the latter is 41 feet long and 18 inches in diameter, these two parts being connected by flat vertical bars so that their axes are parallel and about 4 feet from each other. Each of these parts consists of a copper shell an eighth of an inch in thickness, brazed and riveted together. The float is filled with compressed cotton to exclude water in case it is pierced by projectiles, and carries two slender guide-rods with small flags attached, to enable the operator on shore to observe its rate and direction of motion.

The weight of the torpedo loaded and ready to run is about 7,300 pounds.

The torpedo proper is divided into seven compartments, beginning at the forward end. The *first* compartment contains the charge of 200 pounds of dynamite. The *second* compartment contains the start-and-stop apparatus, a two-cell firing-battery, and a pin projecting to the front for closing the circuit when the torpedo strikes. A second break in the firing circuit is held open by a spring when the engine is at rest, but is closed by the pressure of the gas when the engine is running. This break renders the torpedo safe when not in motion. The torpedo, as arranged, can not be fired by judgment from shore, but only on impact. With the three-wire cable, or one-wire cable, however, provision is made for such firing. In the former case the third wire carries the firing current, and in the latter is accomplished by a step-by-step mechanism.

The start-and-stop apparatus consists of a piston which opens and closes the throttle and which is moved by gas admitted to one side or the other through valves operated by a polarized relay, a current in one direction admitting gas to one side of the piston, and a reverse current to the other.

The *third* and *fifth* compartments contain heaters, to prevent the freezing of the gas by the intense cold produced by its rapid expansion. The heaters consist of series of pipes of gradually-increasing diameter, through which the gas passes, and around which is a heating mixture of sulphuric acid, lime, and water contained in separate receptacles and dumped together just before starting.

The temperature produced is supposed to be about 600° F. In the torpedo case, over each heater, is a safety-valve set at 45 lbs. to relieve pressure from any gas that may be formed by the heating mixture, or by the breaking of the pipes carrying the carbonic acid gas.

The *fourth* compartment is at the center of flotation and contains the flask of liquefied carbonic acid gas. The charge for a mile run is 600 pounds, about 500 of which is used. The pressure in the flask is about 600 pounds to the square inch at 28° to 32° F., the temperature at

which the gas is manufactured. The maximum pressure in the engine during the run, as indicated by an automatically-recording pressure-gauge, is about 95 pounds.

The *sixth* compartment contains the coil of two-wire cable by which the torpedo is electrically started, stopped, and steered, and which is paid out to the rear through the hollow propeller shaft.

The *seventh* compartment contains the engine and steering apparatus. The latter is similar to the start-and-stop mechanism described above, a direct current admitting gas to a piston which moves the rudder in one direction, while a reverse current admits the gas through another valve and moves the rudder in the contrary manner.

The propeller has two blades of 42 inches pitch, and is 31 inches in diameter. It makes about 1,595 revolutions per mile. It is driven by a very compact form of direct-acting engine with six $3\frac{1}{2}$ -inch cylinders, having $7\frac{1}{2}$ inches stroke, and making 700 to 800 revolutions per minute. These cylinders are arranged around and parallel to the propeller-shaft, which is hollow and serves the double purpose of an exhaust pipe and a thimble through which the insulated steering cable is paid out, in addition to its usual office in driving the propeller. The piston rods of the six cylinders are provided with guide-rods and friction-rollers, which work in a groove cut obliquely around the surface of a cylinder which forms part of the propeller shaft, so that at each double stroke of a piston the propeller shaft makes a complete revolution, and there are always four of the pistons acting with full force, while two are passing the dead points.

The operation of making the gas and charging the receivers was witnessed by two members of the Board and appeared to be a remarkably simple and easily conducted operation, the only men employed in it being ordinary laborers, who simply followed a few plain directions.

The gas generating apparatus is double, one generator being worked while the other is being charged with acid and soda. Each generator consists of a spherical receptacle for acid above and connected to a cylindrical receptacle for bicarbonate of soda, the connecting pipe being closed by a stop-cock. The two receptacles are connected by a pipe, which equalizes the pressure in the two and allows the acid to flow into the soda compartment.

A little acid is let in upon the soda, and the mixture stirred by means of a crank projecting through a stuffing box. The gas passes through a purifier to its reservoir, to which is attached a pressure gauge. When the pressure reaches 600 pounds a cock is opened in a pipe leading to the flask, which is immersed in ice and salt, and the gas passes to the flask. When the pressure, thus relieved, falls to about 500 pounds, a little more acid is let in upon the soda, the stirring is renewed, and this operation is repeated until the charge of acid and soda is exhausted, when the generator is cut off from the reservoir and recharged, while the gas-making proceeds with the other generator.

The apparatus is abundantly strong, and there seems to be little possibility of an accident.

Mr. Haight states that they have been using the apparatus for many years, and have never had an accident of any kind.

The cost of the gas, including labor, is 16 cents to 17 cents per pound. With certain proposed improvements it can be made cheaper.

The torpedo is started, stopped, and steered by electricity, communicated through a double cored insulated wire, 9.64 of an inch in diameter, coiled in one compartment of the torpedo and paid out through the hollow propeller shaft as the torpedo advances; 8,400 feet of this

wire can be carried, and a greater length could be provided for if desired.

The quantity of carbonic acid carried is sufficient to run a mile at the highest speed attained, with considerable surplus, and this quantity could also be increased if necessary.

In the trials witnessed by the Board the following speed tests were made, viz :

	Minutes.
Fifth run, June 30, 1888, 1 mile in	3. 04
Sixth run, July 10, 1888, 1 mile in	2. 54
Seventh run, July 13, 1888, 1 mile in	3. 07
Eighth run, July 20, 1888, 1 mile in	3. 06

And by making some changes in the valves, so as to cut off at two-thirds stroke, Mr. Patrick claims to have run the mile in two minutes and twenty-seven seconds, or at the rate of about 24 miles per hour. Although the Board did not witness this last run, there is no question as to the power of the torpedo to make all necessary speed, and Mr. Patrick offers to guaranty a speed of 22 miles per hour in case he contracts to make any torpedoes.

No special trials calculated to test the steering capacity of the torpedo were made, but it is understood that such trials are contemplated, and the Board has been invited to be present. So far as could be judged from the runs made before the Board the torpedo responded promptly when the steering switch was operated, and she appeared to be under complete control of the operator.

Perhaps the best thing that can be said of this or of any similar invention is that in every case it did exactly what was required without a hitch, went off at the appointed time, and without accident or mishap of any kind.

The general discussion of questions relating to auto-mobile torpedoes and their value as a part of our system of sea-coast defense is beyond the scope of this report, but a few words on the subject may not be out of place.

The prime object of this class of weapons is to place a destructive charge of dynamite or some other high explosive in contact or dangerous proximity to the hull of a ship at reasonable distance and explode it at the proper time.

The more important factors involved in this problem are :

First. Facility of delivery at the proper place in good order, and launching.

Second. Simplicity of mechanism and certainty of action.

Third. Speed—freedom from effect of wind and waves.

Fourth. Range of action.

Fifth. Facility of directing.

Sixth. Capacity of chamber for explosives.

Seventh. Cost, and skill required in construction.

Eighth. Questions of storage, preservation, etc.

Ninth. Safety in handling.

Tenth. Capacity for circumventing booms, nets, etc.

In regard to the first of these questions it will be noticed that the size and weight of the torpedo ready for action are such as to require suitable ways for launching, and there will also be required at some convenient point the apparatus for generating gas. In this respect it occupies an intermediate position between the Sims torpedo, for example, which requires more and the Howel which requires less preparation for launching; the latter, however, is not controllable after launching.

Secondly. The mechanism is reasonably simple and certain in its action.

Third. The speed is excellent, and while it is not probable that this or any other known form of controllable torpedo could be successfully operated in a heavy sea, it is also probable that in a moderate sea way and with waves 2 or 3 feet high the torpedo could be guided as far as it could be followed by the eye of the operator.

Fourth. The range could be increased by the methods referred to, but it is already about as great as could be utilized, on account of the extreme difficulty of following up the torpedo and judging of its positions with relation to the vessel it is sent after, even in smooth water. Seeing two large vessels, at a mile and a half distance, and not in line with the observer, approach each other, it is very difficult to tell, without the use of instruments, whether they will pass to the right or left of each other, and with nothing but two small flags visible, as is necessary in case of a controllable torpedo, the problem is even more uncertain. With an elevated point of observation this difficulty may be in a measure overcome and a longer range be made practicable.

Fifth. There appears to be no difficulty in guiding the torpedo within the limits above mentioned, and, while the Board has not yet seen any test of its capacity for making sharp curves, it is probable, from the great length and speed of this torpedo, that it will not curve on a very short radius, and it is not as necessary that it should do so as in the case of a slower moving torpedo. In fact, for the reasons above stated, it will generally be desirable to keep the torpedo as nearly as possible in a straight line between the observer and the object.

Sixth. The charge of 200 pounds of dynamite is deemed ample for this kind of torpedo, but could be increased if desired. If in contact with a ship, it will be practically certain to destroy it, and if not in contact, or nearly so, a very much larger and an unknown quantity would be required. It is better to make sure of contact than to try to operate at an uncertain distance.

Seventh. The cost will probably be very considerable, though the Board is not informed as to the amount. The different parts of the mechanism (engines, valves, polarized relays, etc.) will doubtless require the same degree of skill as is required to construct a locomotive, a dynamo, or other similar machinery.

Eighth. For storage the torpedo would have to be taken apart, carefully coated with oil, lead, and tallow, or similar protective against corrosion, and stored in a dry warehouse.

Ninth. It could only be handled safely by men thoroughly familiar with its construction, and with the handling of high explosives. There will always be more or less danger in handling such apparatus, though the safety devices already described would appear reasonably secure.

Tenth. This torpedo is not arranged for diving under booms, nor, like the Berdan, for secondary explosions, to destroy or penetrate safety-netting.

The inventor proposes to use them in sets of two or more, so that one can clear the way for the others; but the success of this plan must be considered doubtful on account of the unknown extent of the damage that would be done to a ship's protecting net or booms by the first explosion, and the difficulty of directing the second torpedo into the hole made by the first one.

This objection, however, applies to all movable torpedoes with the exception of the Berdan type, which is designed to cause the second or

towed torpedo to dive under the net; but this plan has not, it is believed, been practically tested.

The conditions imposed upon Auto-Mobile controllable torpedoes are to a certain extent incompatible, and it is hardly to be expected that any one torpedo will fulfill all of them perfectly; but it is the opinion of the board that the Patrick torpedo possesses these requirements to a degree that makes it worthy of consideration and trial, when funds are available for the purchase of such weapons.

W. R. KING,

Major of Engineers.

EDWD. MAGUIRE,

Captain of Engineers, U. S. A.

S. W. ROESSLER,

Captain of Engineers.

IRVING HALE,

First Lieut. of Engineers.

RIVERS AND HARBORS, ETC.

APPENDIX A.

IMPROVEMENTS OF RIVERS AND HARBORS IN THE STATES OF MAINE AND NEW HAMPSHIRE.

REPORT OF *LIEUTENANT-COLONEL JARED A. SMITH, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1889, WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

IMPROVEMENTS.

- | | |
|---|---|
| 1. Lubec Channel, Maine. | 13. Channel in Back Cove, Portland, Maine. |
| 2. Moose-a-bec Bar, Maine. | 14. Breakwater at mouth of Saco River, Maine. |
| 3. Narragangus River, Maine. | 15. Saco River, Maine. |
| 4. Breakwater from Mount Desert to Porcupine Island, Maine. | 16. Kennebunk River, Maine. |
| 5. Bagaduce River, Maine. | 17. York Harbor, Maine. |
| 6. Penobscot River, Maine. | 18. Portsmouth Harbor, New Hampshire. |
| 7. Belfast Harbor, Maine. | 19. Bellamy River, New Hampshire. |
| 8. Camden Harbor, Maine. | 20. Cocheco River, New Hampshire. |
| 9. Rockport Harbor, Maine. | 21. Harbor of Refuge at Little Harbor, New Hampshire. |
| 10. Rockland Harbor, Maine. | |
| 11. Kennebec River, Maine. | |
| 12. Portland Harbor, Maine. | |

EXAMINATIONS.

- | | |
|--|-----------------------------------|
| 22. Harbor and channel at Pembroke, Maine. | 24. Medomac River, Maine. |
| 23. Monhegan Island Harbor, Maine. | 25. Hampton River, New Hampshire. |
| | 26. HARRISSECKET River, Maine. |

UNITED STATES ENGINEER'S OFFICE,
Portland, Me., July 9, 1889.

GENERAL: I have the honor to transmit herewith annual reports for the fiscal year ending June 30, 1889, for river and harbor works in my charge.

* * * * *

Very respectfully, your obedient servant,

JARED A. SMITH,
Lieut. Col., Corps of Engineers.
The CHIEF OF ENGINEERS, U. S. A.

A 1.

IMPROVEMENT OF LUBEC CHANNEL, MAINE.

During the fiscal year no work of improvement has been carried on. At the beginning of the year the available funds amounted to but \$10.03, and all work under former contracts had been completed.

By act of August 11, 1888, Congress appropriated \$20,000 for continuing the improvement. The estimate for entire completion of the work, obtained by subtracting amounts appropriated from original estimate for the entire work, was \$22,500. The average of prices obtained have been slightly less than the estimates, so that the amount of the last appropriation will be sufficient to complete the work as heretofore approved.

The lateness of the season when the appropriation became available, together with the time necessarily consumed in complying with formalities required by law and regulations, made it impracticable to commence dredging before the spring of 1889.

Under date of December 13, 1888, advertisements were issued inviting proposals for the work of widening the channel by dredging.

A contract for the work was let to Augustus R. Wright, of Portland, Me.

This contract, approved February 23, 1889, requires the contractor to commence work on or before October 1, 1889, and to complete the work on or before June 30, 1890.

When completed the channel will have a depth of 12 feet, a width of 275 feet throughout, and 25 feet additional width at the bends.

The total length of channel in which the improvements have been made is approximately 11,000 feet. Commencing at the narrows the natural channel for about one-half the distance is straight, and is somewhat wider than the excavated channel over the other half of the distance to Quoddy Bay and anchorage.

The dredged channel is in the shape of a flattened letter S, the two bends requiring a change of direction amounting to 55 degrees and 52 degrees, respectively, in going out to sea. The bends are short and as the tides have a range of 17 feet or more, with consequent rapid currents, such a channel is very difficult for sailing vessels to navigate, and in low stages the masters of steamers prefer to make the long passage around Campo Bello Island rather than to incur the risk of running upon the banks of the cut.

The channel is a thoroughfare to various points on our eastern coast, as well as a factor of safety for the anchorage in Quoddy Roads when the wind changes to easterly points. Local statistics are therefore very incomplete, and there is no means of ascertaining the exact number of passing vessels. In 1882 a record was kept of about 10,000 vessels passing Quoddy Head light-house. No subsequent record has been kept. A record of vessels seen to pass the life-saving station at Lubec in 1887, in day-time and clear weather, shows the number to be 8,683.

Lubec is in the collection district of Passamaquoddy. The nearest port of entry is Eastport, Me. The nearest light-house in the United States is on West Quoddy Head, about 7 miles below.

There is a Canadian light-house on Mulholland's Point, at the narrows opposite Lubec.

The following appropriations have been made for improving Lubec Channel:

By act of March 3, 1879.....	\$44,000.00
By act of June 14, 1880.....	20,000.00
By act of March 3, 1881.....	45,000.00
By act of August 2, 1882.....	20,000.00
By act of July 5, 1884.....	10,000.00
By act of August 5, 1886.....	10,000.00
By act of August 11, 1888.....	20,000.00
Total.....	169,000.00
Expenditures to June 30, 1888.....	148,989.97
Expenditures in last fiscal year.....	503.26
Total expenditures to June 30, 1889.....	149,493.23

Money statement.

July 1, 1888, amount available.....	\$10.03
Amount appropriated by act of August 11, 1888.....	20,000.00
	20,010.03
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$503.26
July 1, 1889, amount covered by existing contracts.....	18,000.00
	18,503.26
July 1, 1889, balance available.....	1,506.77

Abstract of proposals for dredging in Lubec Channel, Maine, opened January 10, 1889.

No.	Name and address of bidder.	Price per cubic yard, measured in scow.
1	Augustus R. Wright, Portland, Me.....	Cents. 35

The contract was awarded to Augustus R. Wright, and dated February 7, 1889.

COMMERCIAL STATISTICS.

The following statistics, for the year ending June 30, 1889, were furnished by the United States collector of customs for the Passamaquoddy district:

Shipping.	Number.	Tonnage.
Vessels arrived from foreign ports.....	778	186,201
Vessels cleared for foreign ports.....	907	201,929
Amount of revenue collected.....		\$68,640.49
Value of importations.....		828,841.00
Value of exportations.....		616,484.00

A 2.

IMPROVEMENT OF MOOSE-A-BEC BAR, MAINE.

This bar, at the eastern terminus of Moose-a-bec Reach, is near the town of Jonesport, Me., about 30 miles east of Mount Desert.

The "Reach" is a thoroughfare of about 12 miles in length, which is traversed by thousands of vessels annually; in addition to this, it forms an admirable harbor of refuge, and is used as such by many vessels, especially in the winter months.

The original project for improving the channel contemplated dredging the bar to a depth of 14 feet and width of 200 feet, and removing the rock known as "Steam-boat Ledge" to a depth of 15 feet at mean low water. The estimated cost of the improvement as amended was \$40,000. The dredging then projected was completed in 1885.

The following appropriations have been made for this work:

March 3, 1881	\$10,000.00
August 2, 1882	10,008.00
July 5, 1884	10,000.00
August 5, 1886	10,000.00
August 11, 1888	15,000.00
Total	55,008.00
Expenditures to June 30, 1889	32,633.64

The balance now available is sufficient to complete the improvement as originally planned, and to widen the channel as now proposed.

The contract for removing Steam-boat Ledge, mentioned in last report, is still incomplete, and it is probable that the contractor will fail to fulfill his obligations. The contractor has already worked two seasons upon the ledge and has only succeeded in removing enough to obtain a single payment for 50 cubic yards, amounting to \$810, 10 per cent. of which was retained.

The contractor has evidently endeavored to do the work, and has incurred an expense far in excess of the payment.

No loss nor inconvenience will result to the improvement should the contract be annulled.

The project recommended in annual reports of 1887 and 1888, which has now been approved, contemplate removing the ledges to a depth of 16 feet at mean low water, and to widen the channel to 300 feet.

Under the appropriation of August 11, 1888, a contract has been made with Thomas Symonds of Leominster, Mass., for widening the channel by dredging. Work under the contract is to be completed before the end of the ensuing fiscal year.

The present project for the improvement is shown upon map opposite page 534, Report of Chief of Engineers for 1886.

The appropriation asked for year ending June 30, 1891, is to be applied to the construction of a small jetty to check cross-currents in the cut, and to removal of ledges.

This work is distant from any commercial center, so that, with small appropriations, it is very difficult to get any competition in letting the work by contract.

If the entire remaining work can be done under one appropriation there can be little doubt that its cost will not exceed two-thirds of the cost if done under four appropriations. Less than \$25,000 in one sum can not be expended with any degree of economy, and even that amount

at such a place, where work can only be carried on a part of the year, is too small to expend to advantage.

The improvement is in the collection district of Machias, Me. The nearest port of entry is Machias, Me. The nearest light-house is Moose Peak.

With the available means it has been found impossible to obtain exact statistics for this work. The commerce of the nearest town is small, but the amount of commerce benefited by the improvement is very large and bears little or no relation to the merely local wants.

Moose-a-bee Reach is a thoroughfare for a large number of vessels and steamers plying between the Dominion of Canada and ports in the United States, and does not depend for its usefulness upon any local commerce. It is estimated that the number of vessels using this thoroughfare and receiving benefits from the improvements is as great as 25,000 annually. Before this improvement was made the route was used by comparatively few vessels.

Money statement.

July 1, 1888, amount available.....	\$4, 158. 23
Amount appropriated by act of August 11, 1888	15, 000. 00
	<hr/> 23, 158. 23
July 1, 1889, amount expended during fiscal year, exclusive of	
liabilities outstanding July 1, 1888.....	\$710. 87
July 1, 1889, outstanding liabilities.....	81. 00
July 1, 1889, amount covered by existing contracts	20, 488. 80
	<hr/> 21, 280. 67
July 1, 1889, balance available	<hr/> 1, 877. 56
{ Amount (estimated) required for completion of existing project	95, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	50, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and	
harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in Moose-a-bee Bar, Maine, opened January 10, 1889.

No.	Name and address of bidder.	Price per cubic yard measured in scow.
		<i>Cents.</i>
1	August R. Wright, Portland, Me	40
2	H. Hamilton & Sawyer, Chebeague, Me	48

All the bids were rejected as too high.

Abstract of proposals for dredging in Moose-a-bee Bar, Maine, opened March 19, 1889..

No.	Name and address of bidder.	Price per cubic yard measured in scow.
		<i>Cents.</i>
1	Hamilton & Sawyer, Chebeague, Me	48
2	Thomas Symonds, Leominster, Mass.....	30
3	Augustus R. Wright, Portland, Me	35

A contract was entered into with Thomas Symonds April 22, 1889.

COMMERCIAL STATISTICS.

The following commercial statistics for the Machias district for the year ending December 31, 1888, were furnished by the collector of customs:

Shipping.	Number.	Tonnage.
Vessels arrived from foreign ports	17	1, 535
Vessels cleared for foreign ports	178	30, 168
Vessels built in the district	5	697
Amount of revenue collected		\$112. 56
Value of importations		1, 172. 70
Value of exportations		67, 994. 72

A 3.

IMPROVEMENT OF NARRAGUAGUS RIVER, MAINE.

The Narraguagus River proper is a small stream flowing across the southwestern portion of Washington County, but the navigable part of the river comprised in the project for improvement is really a tidal arm of the sea or Narraguagus Bay, below the town of Millbridge, which is at the head of navigation.

The last Annual Report gave the details and result of the expenditure of the first appropriation for the work.

During the last fiscal year no work of improvement has been carried on.

The appropriation of August 11, 1888, became available too late in the season to permit of completing contracts and commencing work before the ensuing spring.

A contract has been entered into with Augustus R. Wright, of Portland, Me., for continuing the dredging widening the channel. The work is to be commenced in July and completed on or before the end of December, 1889.

The small amount expended during the fiscal year has been applied to necessary office expenses, preparing drawings, specifications, etc., and for advertising.

The work hitherto completed is a great improvement to the navigation, but, as it is not wide enough to permit steam-boats to turn within its limits, it is but little used by large steamers, which, therefore, wait outside and are lightered of their freight and passengers by a small steamer which runs to the wharf in town.

As soon as the channel can be widened so that the steamers may turn, much delay and expense will be avoided.

Such work can not be carried on to any advantage on the coast of Maine during more than seven months of each year. The point is distant from places where any competition from contractors can be obtained and with small appropriations competition practically disappears as an element in obtaining low prices. All the plant must be taken to and from such distant points for each contract. It is therefore exceedingly desirable that the small amount of \$30,000 estimated to complete the work should be in one sum.

Two regular lines of steamers now run to Millbridge in connection with other points along the coast. Other irregular lines also touch at the same place.

The mouth of the river, in addition to its facilities for commerce with the surrounding country, is used as a refuge and anchorage for steamers

and other vessels in storms. The completion of the channel will there fore add an element of safety as well as convenience.

The improvement is in the collection district of Machias. The nearest port of entry is Machias. The nearest light-house is Narraguagus light-house, on Pond Island.

Money statement.

Amount appropriated by act of August 11, 1888	\$10,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$259.58
July 1, 1889, amount covered by existing contracts	9,000.00
	<u>9,259.58</u>
July 1, 1889, balance available	<u>740.42</u>
{ Amount (estimated) required for completion of existing project	30,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	30,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstracts of proposals for dredging in Narraguagus River, Maine, received January 10, 1889.

No.	Name and address of bidder.	Price per cubic yard measured in scow.
1	Augustus R. Wright, Portland, Me.....	<i>Cents.</i> 20
2	Hamilton & Sawyer, Chebeague, Me.....	26

A contract with Augustus R. Wright was entered into February 7, 1889.

NOTE.—No special statistics for this place have been received. See commercial statistics with report for Moose-a-beo Bar.

A 4.

CONSTRUCTION OF A BREAKWATER FROM MOUNT DESERT TO PORCUPINE ISLAND, MAINE.

In compliance with requirements in river and harbor act of August 5, 1886, a report with plan and estimate for a breakwater from Mount Desert to Porcupine Island was submitted by the officer in charge of the district.

The necessity for improvement arises from the fact that the harbor is exposed to all weather and seas from the south and southeasterly directions, making the anchorage at times so insecure that the best-equipped vessels are sometimes unable to hold their positions at anchor. The landing of passengers at wharves is at such times not only inconvenient but dangerous.

The approved project consists in constructing a breakwater from Porcupine Island to Dry Ledge, and thence in a direct line to a point near the shore of Mount Desert Island, a total distance of 3,425 feet.

The estimate of cost originally submitted was based upon the expectation of a large appropriation and of being enabled to use the stone of the adjacent island, and of carrying on the work by hired labor. Circumstances have combined to prevent the realization of any of these conditions, and it therefore becomes necessary to revise the estimate. The price for stone is that of the lowest proposal received after twice inviting proposals by public advertisement. There are indications that prices will be higher in future unless the work can be carried on under much larger appropriations.

The revised estimate is as follows:

For riprap breakwater to high-water level, 30 feet wide on top, outer slope 1 on 14, inner slope 1 on 1, 580,000 tons of rough stone, at \$1.10	\$638,000.00
11,770 cubic yards superstructure, at \$8	94,160.00
Contingencies of engineering, etc.	67,840.00
Total	800,000.00
Appropriated August 11, 1888.	50,000.00
Expended to June 30, 1889	992.64

The expenses have thus far been for preparatory work, surveys, making maps, advertising, etc.

In February, 1889, proposals for delivering and placing stone in the breakwater were invited by public advertisement. The proposals were opened February 26, 1889, and were all rejected as too high.

March 16, 1889, proposals were again similarly invited. The lowest bid received was higher than the prices which were paid at Rockland and other places; but it had become evident that no better prices could be expected, so that a contract was closed with the lowest bidder, Mr. Fred. Andrews, of Bidderford, Me.

Previous to the end of the fiscal year the contractor was engaged in opening a quarry and in procuring vessels to carry the stone.

It is expected that the delivery of stone will be pushed forward during the summer months, and that the available funds will thus be entirely expended during the ensuing year.

The great advantage of doing this work with annual appropriations not less than \$100,000 can not be too strongly represented, and a larger amount would be the more economical.

The commercial statistics of this harbor for the year 1888 are of sufficient importance to be well studied.

The port will doubtless be used as a refuge when the breakwater is sufficiently near completion.

Money statement.

Amount appropriated by act of August 11, 1888	\$50,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$992.84
July 1, 1889, amount covered by existing contracts	45,000.00
	<u>45,992.84</u>
July 1, 1889, balance available	<u>4,007.16</u>

{ Amount (estimated) required for completion of existing project	750,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	150,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1887.	

Abstract of proposals for furnishing and placing stone on breakwater at Bar Harbor, Maine, received February 26, 1889.

No.	Name and address of bidder.	Price per ton of 2,000 pounds.	
		First class.	Second class.
1	Louis E. Lunt and Aaron Cleave, Portland, Me.	\$1.94	\$1.94
2	George M. Neelon, Deer Isle, Me.	1.23	1.23
3	Thomas A. Rowe, Boston, Mass.	1.92	1.92
4	John A. Hamilton and Rufus A. Soule, Chebeague, Me.	1.87	1.87
5	Horace M. Sargent, Portland, Me., and Isaac M. Webber, Chebeague, Me.	2.00	1.86

All the bids were rejected as too high.

Abstract of proposals for furnishing and placing stone on Breakwater at Bar Harbor, Me., received April 4, 1889.

No.	Name and address of bidder.	Price per ton for stone.	
		First class.	Second class.
1	Joseph Fleurit and Alfred E. Hamilton, Chebeague, Me.....	\$1.45	\$1.45
2	Fred. L. Andrews, Biddeford, Me.....	1.10	1.10
3	William S. White, Rockland, Me.....	1.48	1.48
4	Thomas A. Rowe, Boston, Mass.....	1.49	1.49
5	Rufus A. Soule, Chebeague, Me.....	1.46	1.43
6	Chas. H. Edwards, Quincy, Mass.....	1.58	1.58

A contract was entered into with Fred. L. Andrews, of Biddeford, Me., May 9, 1889.

COMMERCIAL STATISTICS.

The following statistics were furnished by the Collector of Customs at Ellsworth, Me., for the district of Frenchman's Bay for the year 1888:

Shipping.	Number.	Tonnage.
Vessels arrived from foreign ports.....	17	1,678.30
Vessels cleared for foreign ports.....	11	1,015.32
Value of imports.....		\$1,843.73
Amount of collections.....		651.22

Value of freight brought to Bar Harbor, Me., during the year 1888.

By sailing-vessels.....	\$201,872.00
By steam-vessels.....	789,899.12
Total.....	991,771.12

Number of arrivals, departures, and aggregate tonnage of each class of vessels, during the year 1888.

Class of vessels.	Number of vessels.	Aggregate tonnage.	Number of arrivals.	Number of departures.
Steam-vessels (trading).....	17	4,564	4,990	4,990
Steam-vessels (pleasure).....	23	2,760	24	24
Sailing-vessels (trading).....	86	26,548	185	185
Sailing-vessels (pleasure).....	76	4,209	82	82
Total.....	202	38,081	5,281	5,281

A 5.

IMPROVEMENT OF BAGADUCE RIVER, MAINE.

The river and harbor act of August 5, 1886, required an examination or survey of the Bagaduce River, Maine.

A report with estimate of cost of works considered necessary was submitted by the engineer officer in charge February 2, 1888. (See Report of Chief of Engineers for 1888, page 401.)

The project adopted for the improvement consists of deepening the channel to give a width of 100 feet and a low-water depth of 6 feet from

South Penobscot to Bridge's Point. This includes dredging and removing rock. The project also includes removing a small amount of rock in Johnson's Narrows.

By act of August 11, 1888, Congress appropriated \$3,000 for the improvement. As this small sum could not be judiciously expended in a way to accomplish any beneficial result, work on the improvement has been suspended to await the further action of Congress.

An expenditure of \$100 from the appropriation has been incurred in the necessary office work, preparing plans, estimates, etc.

To effect any valuable improvement of the channel all the rock must be first removed; but little result can come from the removal of a portion only.

The estimate of \$24,427.90 for removing all the rock will probably not cover the expense if it can not be done in one contract.

The improvement is in the collection district of Castine. The nearest port of entry is Castine. The nearest light-house is Dice's Head light-house.

Money statement.

Amount appropriated by act of August 11, 1888.....	\$3,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	100.00
July 1, 1889, balance available.....	2,900.00
<hr/>	
{ Amount (estimated) required for completion of existing project.....	43,875.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	25,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

A 6.

IMPROVEMENT OF PENOBSCOT RIVER, MAINE.

The project adopted for improving the portion of the river from Bangor to Crosby's Narrows contemplated widening the channel at Bangor to give a width not less than 300 feet, and a depth of 11 feet at extreme low water, and to remove the bar near Crosby's Narrows, 3½ miles below.

The cost of the work was originally estimated at \$75,000.

The following appropriations have been made for the work:

By act of July 5, 1884.....	\$20,000.00
By act of August 5, 1886.....	15,000.00
By act of August 11, 1888.....	20,000.00
Total	55,000.00
Expenditures to June 30, 1888	24,795.07
Expenditures in last fiscal year	10,144.76

Total expended to June 30, 1889..... 34,939.83

As a result a portion of the improvement between Bangor and Brewer has been completed, leaving only the bar at Crosby's Narrows to be removed.

At the beginning of the year work of dredging to widen the channel at Bangor was in progress under contract, and was finally completed September 24, 1889. From July 1 to September 20 the contractor removed 37,822 cubic yards of material by dredging, and also removed 22½ cubic yards of bowlders.

The channel at Bangor is now completed according to the project adopted, but there is still a small amount of dredging required along the front on the Bangor side.

The act of Congress of August 11, 1888, allotted \$20,000 of the appropriation for improving the Penobscot River to the part from Bangor to Crosby's Narrows.

On the 13th of December, 1888, advertisements were issued inviting proposals to do the dredging.

The proposals were opened January 10, 1889, and were rejected as too high.

Under date of March 1, 1889, proposals were again invited by public advertisement, and were opened March 19. A contract for the work has been made with Mr. Thomas Symonds, of Leominster, Mass.

The contract requires the work to be completed on or before December 31, 1889. The work of dredging under this contract is not yet commenced. The funds now available for that purpose and the balance of \$20,000 to complete the work near Crosby's Narrows are to be expended in completing the project already described.

The act of Congress of August 11, 1888, allotted \$30,000 to improving the river between Bucksport and Winterport.

The project for improving this part of the river as proposed by the officer in charge of the work is described in report of Chief of Engineers for 1888, pages 427 to 431.

The project consists essentially of contraction works of stone to reduce the width of the river to about the average of the places in that vicinity where ample depth is maintained by natural conditions. The officer in charge of the work believed that no dredging would be required, and that if the contraction works were first constructed the cost of dredging would be entirely saved. It was therefore recommended that the appropriation be expended in commencing the contraction works. The Chief of Engineers referred the project to the Board of Engineers. The report of the Board recommended that the dredging be first done, in the belief that the expense of the contraction works may thus be avoided. The project and the report of the Board are therefore given in full. The report recommended that the channel differ slightly in location from that at first proposed. It therefore became necessary to make further borings to determine the character of material throughout the new situation.

Mr. Both, assistant engineer, was therefore directed to make further examinations of the bottom.

Mr. Both's report covering all the borings is appended hereto, and explains some points of interest. He finds the bottom in the channel very soft, mainly of sawdust and sand.

The Board of Engineers observed a considerable difference between the depths shown on Coast-Survey charts and those upon the special survey of the channel at Frankfort Flats. The later examinations show that the channel depths have changed noticeably since the survey was made. This may fairly indicate the movable character of the material.

As there is a vast quantity of sand, sawdust, and mud now in the river, the officer in charge of the work believes that the removal of a few thousand cubic yards in a bend where the river is at least three times its normal width will not make a permanent improvement so long as the conditions which caused the first filling remain essentially unchanged.

In accordance with the recommendations of the Board of Engineers, a project to expend the available funds in dredging the channel has

been approved, and proposals for the work have been invited by public advertisement.

The work of dredging will be completed during the ensuing year.

The amount of \$821.73, expended from this allotment of the appropriation, has been for the necessary surveys, examinations, and other preparatory work.

It is proposed to expend the appropriation asked in carrying out the project for the work in such order as may be deemed most judicious.

The commerce of the Penobscot River is very large. The navigable part of the river reaches the interior of the State at a very central and important point, where it touches the line of railroad which connects the United States with the provinces of New Brunswick and Nova Scotia.

Bangor, at the head of navigation, is a port of entry. Fort Knox, the nearest fortification, is at the narrows opposite Bucksport.

Money statement.

July 1, 1888, amount available	\$10,204.93
Amount appropriated by act of August 11, 1888	50,000.00
	<hr/> 60,204.93
July 1, 1889, amount expended during fiscal year, exclusive of	
liabilities outstanding July 1, 1888	\$10,966.49
July 1, 1889, amount covered by existing contracts	18,000.00
	<hr/> 28,966.49
July 1, 1889, balance available	31,238.44
<hr/>	
{ Amount (estimated) required for completion of existing project	355,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	50,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in Penobscot River, Maine, between Bangor and Crosby's Narrows, received January 10, 1889.

No.	Name and address of bidder.	Price per cubic yard, measured in scow.
		<i>Cents.</i>
1	Moore & Wright, Portland, Me.	85
2	Hamilton & Sawyer, Chebeague, Me.	66
3	Boynton Bros., Boston, Mass.	79

All bids rejected as too high.

Abstract of proposals for dredging in Penobscot River, Maine, between Bangor and Crosby's Narrows, received March 19, 1889.

No.	Name and address of bidder.	Price per cubic yard, measured in scow.
		<i>Cents.</i>
1	Hamilton & Sawyer, Chebeague, Me.	65
2	Thomas Symonds, Leominster, Mass.	39
3	Moore & Wright, Portland, Me.	53

Contract awarded to Thomas Symonds, under date of April 22, 1889.

REPORT OF MR. A. C. BOTH, ASSISTANT ENGINEER.

UNITED STATES ENGINEER'S OFFICE,
Portland, Me., June 26, 1889.

COLONEL: I have the honor to submit the following report upon additional borings made under your directions, May 17 to 23, in the channel of the Penobscot River between Winterport and Bucksport, Me. In my report upon borings made last February at this place, I stated that the material then found could be considered as "easily" scoured by the current to a depth of 22 feet or more at mean low water by the contraction works proposed to be constructed. The locations of these additional borings are shown on the accompanying sketch, and the results tabulated herewith.

A comparison of the depths of water found at the time of making these borings with those found at the time of making the survey in 1887 shows that during freshets considerable changes take place in the formation of the river bottom, which at boring No. 6 amounts to a scour of 6 feet. From the experience of those navigating the river it is learned that these shoals make up again during the summer and obstruct navigation. On the other hand, it appears that during freshets great changes take place in and around the channel above Indian Head, as is shown by soundings made at the same time at this place (while making borings) amounting to a shoaling at boring No. 12 to nearly 9 feet of clear sawdust. From the fact of the material at the upper as well as the lower shoal (consisting mostly of sawdust) being moved about during different stages of the river, it is evident that any improvement of these parts of the river by dredging will soon be obliterated, and the shoals in the channel will be restored by the unaltered condition of the river. The material forming the obstructions being composed nearly entirely of sawdust, mixed with fine sand and mud, leaves no doubt whatever that contraction works of even much less magnitude and cost than those at first projected (previous to borings) will insure a wide, deep, and permanent channel at these places.

Very respectfully, your obedient servant,

A. C. BOTH,
Assistant Engineer.

Lieut. Col. JARED A. SMITH,
Corps of Engineers, U. S. A.

List of borings made in May, 1889, in the channel of the Penobscot River between Winterport and Bucksport, Me.

Number of boring.	Depth at time of survey.	Mean low water at time of boring.	Maximum penetration below mean low water.	Penetration of iron rod through material.	Maximum penetration of auger below mean low water.	Penetration of auger through material.	Character of material.
No. 1.....	<i>Fect.</i> 19.0	<i>Fect.</i> 21.5	<i>Fect.</i> 31.0	<i>Fect.</i> 9.5	<i>Fect.</i> 25.9	<i>Fect.</i> 4.4	Fine loose gray sand all the way.
No. 2.....	18.3	19.3	23.8	4.5	23.4	4.1	Coarse gravel and rocks.
5 feet east of No. 2	18.3	.....	29.1	9.8	.....	.....	At 25.7 feet below mean low water soft sand was found.
No. 3.....	20.5	21.8	32.0	10.2	27.4	5.6	Fine loose sand all the way.
No. 4.....	20.8	19.7	24.3	4.6	.....	.....	Hard gravel and rocks.
5 feet south of No. 4	20.8	.....	26.9	6.2	.....	.....	No sample with auger; tide ran too strong.
No. 5.....	19.0	21.8	29.1	7.3	27.9	5.9	Sawdust and fine loose sand.
No. 6.....	18.0	24.1	32.2	8.1	28.4	4.3	All soft sand, with little gravel.
No. 7.....	19.8	24.8	32.6	7.8	30.3	5.5	Very soft sand and sawdust mixed.
No. 8.....	17.5	22.0	31.9	9.9	28.8	6.8	Very soft; rod pushed down hand over hand.
No. 9.....	21.7	21.0	31.3	10.3	29.5	8.5	Very soft sand and sawdust.
No. 10.....	18.5	20.6	24.8	4.2	22.8	2.2	Coarse gravel and rocks.

List of borings made in May, 1889, in the channel of the Penobscot River, etc.—Continued.

BORINGS ABOVE INDIAN HEAD.

[No samples were taken of borings Nos. 11 to 19, the material being sawdust.]

Number of borings.	Depth at time of survey.	Mean low water at time of boring.	Maximum penetration below mean low water.	Penetration of iron rod through material.	Maximum penetration of auger below mean low water.	Penetration of auger through material.	Character of material.
	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	
No. 11.....	16.8	13.9	30.8	.....	.....	.....	Clear sawdust to this depth.
No. 12.....	18.0	9.4	29.5	.....	.....	.....	Clear sawdust to this depth, very soft.
No. 13.....	15.1	12.1	30.8	.....	.....	.....	Clear sawdust to this depth.
No. 14.....	16.3	13.2	31.6	.....	.....	.....	Do.
No. 15.....	16.5	11.7	30.8	.....	.....	.....	Do.
No. 16.....	11.7	11.7	29.8	.....	.....	.....	Do.
No. 17.....	17.2	12.7	31.6	.....	.....	.....	Do.
No. 18.....	17.5	17.6	32.7	.....	.....	.....	Clear sawdust to this depth; very soft sand (slush) underneath.
No. 19.....	11.9	14.6	31.3	.....	.....	.....	Clear sawdust to this depth.

COMMERCIAL STATISTICS.

The following commercial statistics for the year 1888 were furnished by the collector of customs for the Bangor district:

Shipping.	Number.	Tonnage.
Arrivals from foreign ports	18	5,704
Clearances for foreign ports	42	15,238
Vessels built (steamers)	2	21,175

Amount of duties collected.....	\$109,633.00
Amount of tonnage tax collected.....	233.48
Value of dutiable importations.....	485,043.08
Value of free importations.....	585,272.00
Value of exportations.....	181,868.00

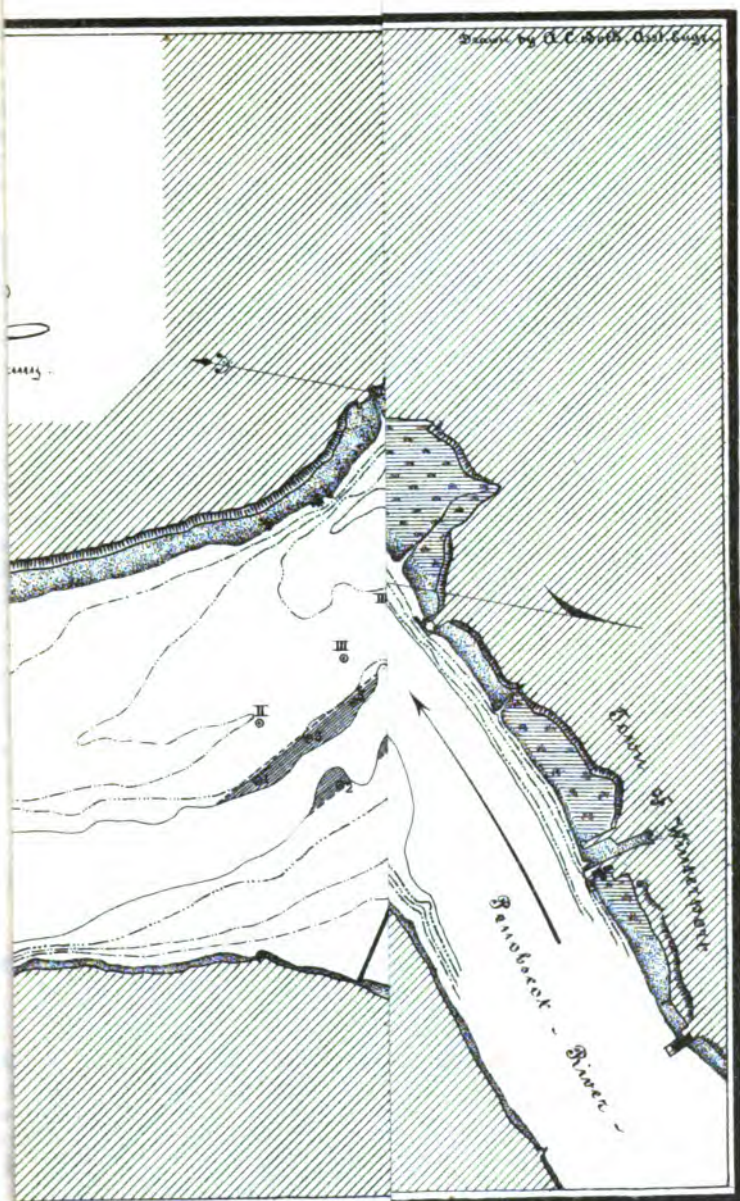
PROJECT FOR THE IMPROVEMENT OF THE PENOBSCOT RIVER BETWEEN BUCKSPORT AND WINTERPORT, MAINE.

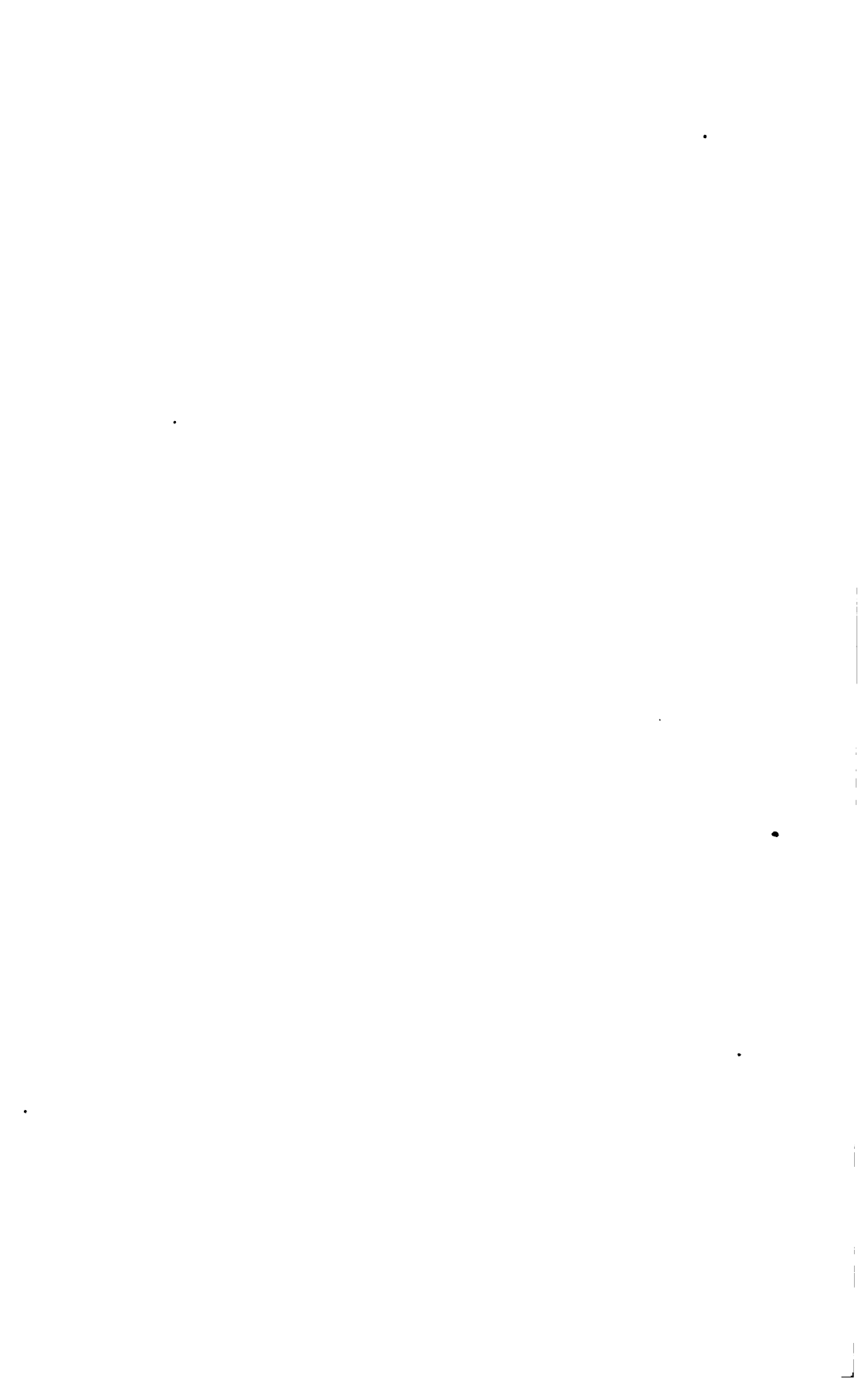
UNITED STATES ENGINEER'S OFFICE,
Portland, Me., December 28, 1888.

SIR: In compliance with instructions in Department letter dated August 22, 1888, I have the honor to submit the following project for expenditure of \$30,000 appropriated by act of August 11, 1888, for improving Penobscot River between Bucksport and Winterport, Maine:

The forwarding of that project has been delayed in order to obtain, if practicable, some further information regarding the character of the bottom, as indicated in my letter of October 24, 1888. There has, however, been an unusual rainfall during the past few months, and for some time there has been a large amount of floating ice. While the borings are desirable, yet it has not seemed that the immediate necessity justified the greatly increased expense which would be entailed by

Entered by U.C. Smith, Oct. 1880.





making the examinations under a maximum of unfavorable circumstances. The borings were desired more especially for the purpose of ascertaining whether dredging is likely to be required to deepen the channel after contraction works are built, or whether the bottom is likely to scour as a result of the reduced cross-section where the resultant current will flow. It therefore seems best not longer to delay the preparations for work upon the jetties, which must be first built in any event.

I forward by mail in a separate package a tracing showing in outline the general features of the map and project transmitted with my letter of January 11, 1888. The works proposed in the original project were five jetties or wing-dams and deepening the channel in two places by dredging; total estimated cost \$365,000. The object of these works was to obtain a good channel of 22 feet in depth at mean low water.

The most important of the jetties proposed is the one marked C upon the tracing. In the original project this jetty was located on the line *d f*. The location now proposed has the outer end and beacon at the same point as before, but connects the beacon with the shore along a line having less depth of water, so that the expense of construction will be reduced from 25 to 30 per cent.

The locations of the jetties have been decided upon after much study of the situation, with all the information available, and I believe they will accomplish the purpose for which they are designed.

I recommend that the appropriation be applied to the construction of the Jetty C, commencing at the shore and extending outward as far as funds may permit. It is estimated that the entire jetty, as here shown, will require 75,000 tons of stone, allowing 2 feet for settlement.

The amount of available funds will probably pay for one-half the stone in the jetty, and, if so, will complete a length of 2,400 feet from the shore. This will afford an opportunity for observing effects upon the current and of modifying the plan if desirable before completing the jetty.

The only practicable method of doing the work at present is by contract in the usual manner; the superintendence and contingent expenses to be by hired labor and purchases in open market.

Very respectfully, your obedient servant,

JARED A. SMITH,
Lieut. Col., Corps of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

LETTER OF THE SENIOR MEMBER OF THE BOARD OF ENGINEERS.

THE BOARD OF ENGINEERS, ARMY BUILDING,
New York City, January 30, 1889.

COLONEL: The Board of Engineers desires some further information in connection with your project of December 28, 1888, for the expenditure of \$30,000 between Winterport and Bucksport on the Penobscot River.

First. The Board wishes to know what the material is along the line of the proposed channel at Jetty C to a depth of 22 feet below low water, the soundings being made with a gas-pipe, steel rod, or other device.

Second. Is the supply of sawdust, slabs, etc., for the formation of shoals now diminishing in consequence of the exhaustion of lumber or is it still very large?

Third. The Coast Survey map of the river shows much deeper water on shoals than your survey. Do you consider this an actual shoaling; and if so, is it due to sawdust, and so forth, whose supply may rapidly diminish in the future?

Fourth. It is noted that below Bangor you resort to dredging instead of contraction work. Why is dredging more advisable here than below Winterport?

Fifth. Many important water ways have widths less than 800 feet; for instance the South Pass; the intervals between piers of bridges on the Ohio and Mississippi rivers. Is 800 feet on the Penobscot the minimum permissible?

Sixth. At what time do you begin work in the spring?

Very respectfully, your obedient servant,

O. B. OOMSTOCK,
Bvt. Brig. Gen., U. S. A.,
Senior Member Present.

Lieut. Col. JARED A. SMITH,
Corps of Engineers, U. S. A.

LETTER OF LIEUTENANT-COLONEL JARED A. SMITH, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Portland, Me., February 1, 1889.

COLONEL: I have to acknowledge receipt of letter of January 30, from the Board of Engineers.

The information desired can not be furnished in a complete form at present. I have, however, instituted measures to examine the bottom by borings, although the season is such as to present a maximum of unfavorable condition for such work.

The following replies cover the information as far as can now be given, viz:

First. Examinations are to be made as soon as possible to ascertain the kind of material to a depth of 22 feet along line of channel at Jetty C.

Second. So far as I can ascertain there have been no slabs, edgings, etc., thrown into the river during the past eight or ten years. Sawdust however, is still thrown into the river, and there is no present means of indicating any limit to the time when such deposits will be made. Sawdust comes in mainly from the unnavigable parts of the river and its tributaries. It is apparent that the deposits of sawdust are not generally in the channel, but in eddies made by the ebb tide. At Farnkfort Flats the sawdust accumulates immediately below the point near Jetty E. Large quantities of the sawdust are carried away each summer upon small vessels, and it is extensively used for fertilizing. This removal of sawdust does not appear to affect the situation in the least. The only deposits of sawdust which have formed without a nucleus of slabs or other matter appear to be in the eddies above mentioned.

Third. I have no means of knowing whether the shoaling is actual or not, except by comparison of the maps, and there is no reason to doubt the reliability of the map made in this office. The low-water plane to which the surroundings are referred is from references established by the Coast Survey.

In times of freshets the river is muddy, and it seems probable that

the shoaling has actually occurred by a deposit of earthy material mixed perhaps with mill-waste. This can be determined more definitely when the borings are made. Borings were not made with the survey owing to a lack of funds. * * *

Fourth. The conditions below Bangor are entirely different from those below Winterport. Near Bangor the shoals were mainly of gravel, small stones, hard material, and boulders; the river at that place does not exceed a normal width and is nearly straight. Near Crosby's Narrows, 3 miles below Bangor, the deposit is caused by an accumulation of slabs, edgings, etc., which, when once imbedded, can not be removed by scour. While the tide rises about 13 feet, there is ordinarily no flood current, the rise being due to the inflow and tidal effects below.

The outflow is therefore akin to pulsations, its total being nearly the same as the volume falling over the dam above, while at Winterport the flood current lasts some hours, and the outflow is therefore largely increased.

So long as the throwing of slabs, etc., into the river was continued circumstances were favorable for their formation into a bar a few miles below Bangor; but now that the throwing in of coarse waste is discontinued, there is no probability that the bar will form there again after the channel is dredged.

Fifth. The estimate of cost of the improvement, embodied with the report of my assistant, which he made in constant consultation with the officer in charge, covered the dredging of a channel 400 feet wide only. (See Report of Chief of Engineers, 1888, Part I, page 431.)

It was thought possible that even that amount might be greatly reduced, or eliminated entirely, depending, of course, on the character of the bottom. (See fifth and sixth paragraphs of my report, on page 428, Report of Chief of Engineers for 1888.)

The channel of 800 feet was merely outlined as the probable ultimate width which the current might scour should the material prove to be free.

The channel for which dredging was estimated is indicated on the map within the limits of the broader one. The original map forwarded to the Chief of Engineers, with the project dated January 11, 1888, contained the soundings complete, and definitely outlined a dredged channel of 400 feet wide. The sheet also contained cross-sections of the river at various points from which the studies were made. I infer that the Board of Engineers has not received the original complete map.

Very respectfully, your obedient servant,

JARED A. SMITH,
Lieut. Col., Corps of Engineers.

Col. HENRY L. ABBOT,
Corps of Engineers, U. S. A.,
President Board of Engineers.

LETTER OF LIEUTENANT COLONEL JARED A. SMITH, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Portland, Me., February 13, 1889.

COLONEL: I forwarded by mail to-day in a separate package a tracing showing in outline the portion of the Penobscot River lying between the proposed Jetties A and D.

On receipt of the Board's letter indicating that borings were desired, I directed Mr. A. C. Both, assistant engineer, to proceed to the location and to make the borings, which were indicated in advance approximately upon the map.

The work occupied about ten days' time owing to the extreme cold, heavy running ice on both ebb and flood tides, with wind and snow. These conditions, added to the ice frozen out from the shores, made it extremely difficult to reach the place or to remain in one spot long enough to get the information required.

I am glad to report, however, that the borings were successfully made as desired, with the exception of one place marked I upon the tracing. The following is the record as submitted by Mr. Both:

Number of survey.	Sounding at mean low water.	Penetration below mean low water.	Material.
	<i>Feet.</i>	<i>Feet.</i>	
No. II	12.2	28.0	All sawdust, did not reach hard bottom.
No. VI	11.0	25.2	Fine gravel and sand.
No. V	12.5	29.3	Fine sand and gravel.
No. IV	17.8	33.1	2 feet sawdust and silt, rest soft sand and gravel.
No. III	17.6	32.0	2 feet sawdust, 1 foot silt, rest soft sand.
No. III ^a	15.0	30.2	2 feet sawdust and silt, rest soft sand.
No. III ^b	17.3	26.9	Medium hard gravel all the way.
Head of Jetty C ^a	18.0	21.4	Hard, coarse gravel mixed with small bowlders.
b	17.5	20.3	

The material found is such as to leave no doubt that the channel may be sufficiently deepened by the effect of contraction works.

The material is especially soft at Nos. II, III, III^a, and IV, so that it has suggested the propriety of changing the location of Jetty C to the line indicated in red in order to obtain an increased scour at the point where borings V and VI are located.

Very respectfully, your obedient servant,

JARED A. SMITH,
Lieut. Col., Corps of Engineers.

Col. H. L. ABBOT,
Corps of Engineers,
President Board of Engineers.

REPORT OF THE BOARD OF ENGINEERS.

THE BOARD OF ENGINEERS, ARMY BUILDING,
New York City, ———, 1889.

GENERAL: The Board of Engineers has the honor to submit the following report on the project of Lieut. Col. J. A. Smith for improving the Penobscot River between Bucksport and Winterport, Me., dated December 28, 1888, referred to the Board by your indorsement dated January 8, 1889. This project is limited to the expenditure of \$30,000, appropriated by the river and harbor act of August 11, 1888, but forms a part of the project proposed by Colonel Smith in his report of January 11, 1888, House Ex. Doc. No. 133, Fiftieth Congress, first session, except as to the location of Jetty C, toward the construction of which he proposes to apply the funds now available.

As stated by Colonel Smith, no borings were made to determine the character of the bottom, owing to the lack of funds. The assistant engineer who made the survey states (Ex. Doc. above mentioned, page 20) that—

From observations made during the survey, I feel inclined to believe that these shoals consist mostly of slabs, edgings, and sawdust deposited here by favorable eddies and accumulated during many years.

I would recommend, however, that before actual work is commenced a thorough examination of these shoals be made, to determine without doubt if a continuous channel of 22 or 24 feet depth can be obtained by the scouring action produced by contraction works alone, or if it will be found necessary to dredge a certain portion of the proposed channels and thereby hasten the availability of these channels for navigation.

In his project of December 28, 1883, Colonel Smith states that no borings had yet been made, for reasons which he gives.

The Board, considering that this, as well as some other information, was essential for a proper consideration of the project, called on Colonel Smith for the following information :

What is the nature of the material along the proposed channel at Jetty C ?

Is the supply of sawdust, slabs, etc., for the formation of shoals now diminishing in consequence of the exhaustion of lumber, or is it still very large ?

In view of the fact that the Coast Survey map of the river shows much deeper water on the shoals than Colonel Smith's surveys, is this considered an actual shoaling ; and, if so, is it due to sawdust, etc., whose supply may rapidly diminish in the future ?

It being noted that below Bangor Colonel Smith resorts to dredging instead of contraction works, why is dredging more advisable there than below Winterport ?

As many important water-ways have widths less than 800 feet, is such width the minimum permissible on the Penobscot River ?

To this Colonel Smith replied in letters of February 1 and 13, 1889, herewith, with a tracing showing location and results of borings.

Owing to the large cost of the project, estimated by Colonel Smith at \$365,000, for improving a stretch of $3\frac{1}{4}$ miles of river, and the uncertain effect of the proposed dikes, the question is presented whether it may not be more economical and beneficial to navigation to excavate channels through the shoals and depend upon periodical dredging for maintenance.

Experience elsewhere indicates that in interior channels of this character in tidal waters, a channel once excavated can often be maintained by dredging at comparatively small expense.

With the present appropriation a channel to the required depth and nearly 200 feet wide can, according to the estimate furnished, be made through the shoal at Jetty C, thus giving some relief to navigation, while that amount, if wholly applied to dike construction, will only build half the Jetty C, which would produce little effect.

The Board is therefore of the opinion that the work to be done with the present appropriation should be the dredging of a channel to the required depth and as wide as possible, near Jetty C, before any dikes are built. The result of this dredging will indicate more clearly whether dikes are necessary ; and, if so, furnish better information as to the proper location, height, etc. The dredging should follow the line of the existing channel, as indicated by the deep-water curves, which differ slightly from the channel proposed to be dredged by Colonel Smith.

The papers referred by you, which have formed the subject of this report, are herewith returned.

Respectfully submitted.

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.,
President of the Board.
 O. B. COMSTOCK,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.
 D. C. HOUSTON,
Lieut. Col. of Engineers, Bvt. Col., U. S. A.
 G. L. GILLESPIE,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

[First Indorsement.]

OFFICE CHIEF OF ENGINEERS,
 U. S. ARMY,
 March 6, 1889.

Approved.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

A 7.

IMPROVEMENT OF BELFAST HARBOR, MAINE.

The harbor was originally shallow along the wharf-fronts, east side, so that vessels could only land on high stages of water.

A project for the improvement of this harbor was adopted in 1876, the object being to enable vessels drawing 10 to 12 feet of water to reach the wharves at all stages of the tide.

Up to June 30, 1887, there had been expended the sum of \$22,213.84.

The west side of the harbor has been improved, so that there are 10 feet at mean low water in the upper part and 11 to 12 feet in the lower part.

In January, 1888, a special examination was made of the harbor, and the report, dated February 2, 1888, recommended that the area of the harbor be increased by dredging on the northeast side. (See Report Chief of Engineers, 1888, pp. 381 and 382.)

The river and harbor act of August 11, 1888, required an examination or survey of the harbor. A report of a preliminary examination was submitted November 30, 1888.

The harbor having been reported worthy of improvement, the officer in charge of the improvement has been directed to make a survey of the harbor, and to submit a plan of improvement, with estimate of cost.

The survey will be made during the ensuing summer.

Money statement.

July 1, 1888, amount available	\$2,786.16
July 1, 1889, balance available	2,786.16

COMMERCIAL STATISTICS.

The following are the commercial statistics for Belfast Harbor, Maine, for the year 1888:

Shipping.	Number.	Tonnage.
Vessels cleared for foreign ports.....	14	1,000
Vessels arrived from foreign ports.....	9	1,109
Vessels built.....	1	.....
Amount of revenue collected.....		\$857.88
Value of importations.....		1,153.00

The above statistics were received from the collector of customs for the Belfast district.

A 8.

IMPROVEMENT OF CAMDEN HARBOR, MAINE.

Under the provisions of the river and harbor act of August 5, 1886, an examination and survey were made of Camden Harbor. The preliminary report and report of survey are included in report of Chief of Engineers for 1888, pages 403 to 407.

The harbor is so shoal that at mean low water vessels drawing more than 6 feet can not reach the wharves. The following is the project adopted for its improvement.

- (1) Dredging approaches to depth of 12 feet.
- (2) Dredging channels to depth of 10 feet.
- (3) Removing middle ground.

The river and harbor act of August 11, 1888, having appropriated \$5,000 for commencing the improvement, plans have been perfected and a contract has been made for dredging as far as funds permit.

The expenditures during the fiscal year have been \$94.86.

It is proposed to spend the funds available, and for which estimates are submitted, in carrying on the improvement in the order named.

Camden is a thriving village on the west side of Penobscot Bay. The commercial interests of the place were fairly set forth in preliminary report on pages 403 and 404, Report of Chief of Engineers for 1888.

No special statistics for this port have been received.

Camden is in the collection district of Belfast. The nearest light-house is on Negro Island, at entrance to harbor.

The nearest fortification is Fort Knox, at Bucksport Narrows.

Money statement.

Amount appropriated by act of August 11, 1888	\$5,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$94.86
July 1, 1889, amount covered by existing contracts.....	4,500.00
	<hr/> 4,594.86
July 1, 1889, balance available	405.14
	<hr/>
{ Amount (estimated) required for completion of existing project.....	549.30
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	200.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in Camden Harbor, Maine, opened January 10, 1889.

No.	Name and address of bidder.	Price per cubic yard, measured in scow.
		Cents.
1	Moore & Wright, Portland, Me.....	30
2	Edgar P. Lovering, Portsmouth, N. H.....	25
3	Hamilton & Sawyer, Chebague, Me.....	29
4	Boynton Bros., Boston, Mass.....	32

Contract awarded to Edgar P. Lovering, Portsmouth, N. H. Date of contract, February 5, 1889.

A 9.

IMPROVEMENT OF HARBOR AT ROCKPORT, MAINE.

This harbor is upon the west side of Penobscot Bay about $6\frac{1}{2}$ miles north of Rockland. It is open on the south and has ample depth of water except near the wharves at the upper or northern limit.

The obstructions are from the shallow water near the wharves and from ice in winter, the ice being doubtless made worse by the shallow water.

It is proposed to deepen the part near the wharves so as to afford a depth of 12 feet at mean low water.

One appropriation has been made for this work, viz:

By act of August 11, 1888..... \$10,000

The estimate for the entire improvement was but \$14,000, based upon the supposition that it could be done under a single appropriation.

Specifications were prepared and proposals for dredging were invited in December, 1888. A contract for dredging as far as available funds permit was awarded to the lowest bidder, Mr. E. P. Lovering, of Portsmouth, N. H. The work is to be completed at any time during the ensuing year at the option of the contractor.

The transportation of a complete plant for dredging is an expensive item, and this item is as large for a small work as a large one.

With an appropriation of \$4,000 for dredging at a point distant from a commercial center the transportation and other contingent expenses consume so much that there is little left to apply to the work.

As the project, if completed, must be in a contract for a small amount, it becomes necessary to increase the amount originally estimated.

Rockport Harbor is a place where a large amount of shipping is interested.

No special statistics of the port have been received for the last year.

The commercial interests were quite fully set forth in my preliminary report on pages 407 and 408, Report of Chief of Engineers for 1888.

Rockport is in the collection district of Belfast. The nearest light-house is on Indian Island at the entrance to the harbor.

Money statement.

Amount appropriated by act of August 11, 1888.....	\$10,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$178.63
July 1, 1889, amount covered by existing contracts.....	9,000.00
	<u>9,178.63</u>
July 1, 1889, balance available.....	<u>821.37</u>

{ Amount (estimated) required for completion of existing project.....	\$5,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	5,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in Rockport Harbor, Maine, opened January 10, 1889.

No.	Name and address of bidder.	Price per cubic yard, measured in scow.
		<i>Cents.</i>
1	Moore & Wright, Portland, Me.....	26
2	Hamilton & Sawyer, Chebeague, Me.....	25½
3	Edgar P. Lovering, Portsmouth, N. H.....	20
4	Boydton Bros., Boston, Mass.....	30

The contract was awarded to Edgar P. Lovering, Portsmouth, N. H. Date of contract February 5, 1889.

A 10.

IMPROVEMENT OF HARBOR AT ROCKLAND, MAINE.

At the beginning of the fiscal year the funds previously appropriated for the work had been so nearly expended that work was suspended awaiting further appropriations.

The breakwater from Jameson's Point had been completed its full length to a height of 5 feet above mean low water, and 12 feet wide on top, and the outer end had been raised to high-water level and given a width of 20 feet on top for a distance of 271 feet.

The river and harbor act of August 11, 1888, appropriated \$30,000 for continuing the work. This was too late to permit of resuming work under a formal contract before winter should set in.

In January, 1889, proposals for placing stone upon the Jameson's Point breakwater to raise it to high-water level and give it a top width of 20 feet were invited by public advertisement.

The lowest bidder was Mr. John F. Hamilton, of Portland, Me., and the contract was awarded to him. Work of delivering stone under this contract was commenced April 16. Previous to June 30, 1889, the contractor had placed 13,599 tons of stone upon the breakwater; 371 feet of the enlarged section was completed, making 642 feet, including the work of the previous year completed to high-water level. Work under the contract will be continued as far as available funds will permit. This will probably complete the Jameson's Point breakwater to high-water level as far toward shore as will be necessary.

In continuing the improvement of the harbor it is a question whether it will be best to commence a new breakwater as was originally proposed or to extend the breakwater already constructed from Jameson's Point. It is urged by many persons interested in the navigation and commerce of the place that the latter method will be of far greater benefit. The harbor is often filled with vessels which come in for anchorage and shelter, and the question of room is one of much importance.

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The following appropriations have been made for this work:

Act of June 14, 1880.....	\$20,000.00
Act of August 2, 1882.....	40,000.00
Act of July 5, 1884.....	40,000.00
Act of August 5, 1886.....	22,500.00
Act of August 11, 1889.....	30,000.00
Total	152,500.00
Total expended to June 30, 1889.....	134,337.47

Funds which may be appropriated for the ensuing year will be expended in carrying on the construction of breakwater on the plan which may be considered most judicious.

Rockland is a port of considerable commercial importance and its harbor forms an excellent refuge, for which it is much used.

Rockland is a port of delivery in the collection district of Waldoborough. The nearest port of entry is Waldoborough. The nearest light-house is Owl's Head, 2 miles distant.

Money statement.

July 1, 1888, amount available	\$2,183.40
Amount appropriated by act of August 11, 1888	30,000.00
	32,183.40
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$12,129.37
July 1, 1889, outstanding liabilities.....	1,891.70
July 1, 1889, amount covered by existing contracts	15,971.51
	29,992.58
July 1, 1889, balance available	2,190.82
{ Amount (estimated) required for completion of existing project.....	497,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	75,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for furnishing and placing stone on the breakwater at Rockland, Me., February 12, 1889.

No.	Name and address of bidder.	Price per ton of 2,000 pounds.
1	Joseph F. Curt and Alfred C. Hamilton, Chebeague, Me.....	\$1.02
2	John F. Hamilton, Portland, Me.....	.93
3	John A. Hamilton and Rufus A. Soule, Chebeague, Me.....	1.05
4	Thomas A. Rowe, Boston, Mass.....	.97
5	Bodwell Granite Company, Rockland, Me.....	1.05

A contract was entered into with John F. Hamilton, Portland, Me., February 28, 1889.

COMMERCIAL STATISTICS.

Number of steam-boat lines.....	4
Number of steamers	9
Number of landings made at Rockland during 1888.....	1,030
Number of vessels owned	200
Number of sailing vessels engaged in freighting lime	300

EXPORTS.

Lime	casks.. 1,400,000
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IMPORTS.

Coal	tons..	20,000	Lobsters (live).....	29,000
Wood	cords..	36,675	Fish	pounds.. 3,690
Piling	feet..	4,450	Eggs	dozen.. 8,950
Lumber	do ..	159,979	Potatoes.....	bushel.. 6,190

Foreign arrivals	600
Amount of duties collected	\$1,691.15

The following statistics for the year 1888 were furnished by the collector of Wal-doborough district:

Shipping.	Number.	Tonnage.
Vessels arrived from foreign ports	608	50,015
Vessels cleared for foreign ports	620	44,744
Vessels built in the district	7	4,085.97

Amount of revenue collected	\$3,791.56
Value of importations	74,240.00
Value of exportations	9,951.00

A II.

IMPROVEMENT OF KENNEBEC RIVER, MAINE.

Under the requirements of the river and harbor act of August 5, 1886, an examination and survey of the Kennebec River at Bath, and from Augusta to the lower end of Swan Island was completed in August, 1887, the complete reports with project and estimate of cost of improvement are included in Report of Chief of Engineers for 1888, pages 412 to 425.

The project for the improvement consists in removing the shoals at Beef Rock, Hatch's Rock, and South Gardiner by means of wing-dams and training-walls; to remove rocks in harbor at Bath and at Love-joy's Narrows by blasting; and to dredge the shoals from Augusta to Gardiner.

The river and harbor act of August 11, 1889, having appropriated \$75,000 for commencing the improvement, plans and specifications were perfected, and in February, 1889, proposals for constructing the jetties and training-walls at Hatch's Rock and Beef Rock shoals were invited by public advertisement.

The lowest bidder was Mr. M. J. Wheeler, of Savannah, Ga., and the contract was awarded to him.

Subsequent to this award Mr. Wheeler found himself embarrassed by business complications which were likely to interfere with his prosecution of the work. Upon request of the parties interested the principal guarantor for Mr. Wheeler assumed the responsibility of the contract and entered into a formal agreement accordingly, in the usual form of contract. Under this contract the improvement has been commenced and will be pushed forward as far as available funds permit.

On the 30th of June the amount accomplished was insufficient to produce any perceptible effect upon the channel.

The amount available is sufficient to complete the works proposed at Hatch's Rock, and to construct more than half the work required at Beef Rock Shoal.

There had been delivered 4,542½ tons of stone and 359 fascines.

The expenditures of the fiscal year have amounted to..... \$6,186.54

It is proposed to apply funds which may be appropriated to the completion of work at Beef Rock Shoal, and to such other parts of the project as may appear most suited to accomplish the desired result.

The Kennebec River is one of the largest highways of commerce in New England.

The exports of lumber, granite, and ice amount to several thousands of cargoes, and the miscellaneous traffic of steamers and other vessels is large. Such statistics as can be obtained with the means at hand are only partial, and give but an approximate idea of the commerce of the river.

This subject was treated in a general way in preliminary report on page 416, Report of Chief of Engineers, 1888.

The improvement is in the collection district of Bath.

The nearest port of entry is Bath.

The nearest fortification is Fort Popham, near the mouth of the Kennebec River.

The nearest light-house is Pond Island, near the mouth of the river.

Money statement.

Amount appropriated by act of August 11, 1888.....	\$75,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$1,361.60
July 1, 1889, outstanding liabilities.....	4,824.94
July 1, 1889, amount covered by existing contracts.....	65,175.06
	<u>71,361.60</u>
July 1, 1889, balance available.....	<u>3,638.40</u>

{ Amount (estimated) required for completion of existing project.....	335,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	150,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for stone and brush training walls and jetties, Kennebec River, Maine, received March 9, 1889.

No.	Names and residences of bidders.	Hatch's Rock Shoal.		Beef Rock Shoal.		Price per ton pier-heads.
		Stone, per ton.	Fascines, each.	Stone, per ton.	Fascines, each.	
1	Thomas A. Rowe, Boston, Mass.....	\$1.45	\$2.50	\$1.45	\$2.50	\$900
2	M. J. Wheeler, Savannah, Ga.....	.09½	.85	.99½	.85	500
3	George Willett Andrews, Biddeford, Me.....	1.07	1.43	1.07	1.43	600
4	Joseph F. Curitt and Alfred E. Hamilton, Chebeague, Me.....	1.46	2.25	1.46	2.25	625
5	Rufus A. Soule, Chebeague, Me., and H. M. Sargent, Portland, Me.....	1.22½	2.25	1.22½	2.25	600

The contract was awarded to M. J. Wheeler, Savannah, Ga. Contract dated June 13, 1889, was made with B. D. Greene, principal guarantor for M. J. Wheeler.

COMMERCIAL STATISTICS.

The following statistics for the year 1888 were furnished by James W. Wakefield, United States collector at Bath, Me.:

Number of vessels entered from foreign ports.....	370
Number of vessels cleared for foreign ports.....	11
Number of vessels entered from domestic ports.....	38

Number of vessels cleared for domestic ports.....	11
Value of exports	\$1,610.00
Value of imports	\$138,516.00
Total collections.....	\$59,961.92
Number of vessels built, 24; tonnage	11,148.96
Number of arrivals coastwise about.....	4,000

(This does not include the semi-weekly line of steam-boats from Boston, nor the several daily lines to the islands, nor the sixteen tug-boats which are constantly plying the river.)

The following articles were shipped from Richmond, Me., during the year 1888:

By steamers.

Hay	tons..	700	Apples	barrels..	800
Eggs	dozen..	60,000	Fresh shad.....	do....	1,100

Besides large quantities of veal, mutton, and poultry.

By sailing vessels.

Long lumber.....	feet..	5,500,000	Edgings and slabs.....	cords..	2,800
Shingles, lath, clapboards, and staves.....		6,430,000	Ice (estimated).....	tons..	400,000
Broom-handles		50,000	Hay, large quantities, no record kept.		

Received by water.

Coal	tons..	3,000	Coal-oil	barrels..	2,000
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The following articles were shipped from Augusta, Me., during the year 1888:

Lumber	feet..	5,000,000	Hay, ground wood pulp, large quantities.		
Granite (including Hallowell), tons.....		10,000	Doors, sash, and blinds, large quantities.		
Broom-handles		1,000,000			
Ice (no figures), Hallowell alone	tons..	25,000			

Receipts by water.

Coal	tons..	15,000	Lime and cement.....	casks..	20,000
Plaster, stone and commercial fertilizers	tons..	400	Lumber	feet..	4,000,000

Number of arrivals of steam-vessels.....	500
Number of arrivals of sailing vessels.....	250

(This does not include the small class of pleasure boats.)

The class of vessels employed in carrying freight are schooners of from 90 to 300 tons, with a draught of from 6 to 10 feet.

A 12.

IMPROVEMENT OF HARBOR AT PORTLAND, MAINE.

The project for this improvement consists in dredging a channel 500 feet wide and 29 feet deep at mean low water from deep water of the outer channel to the front where the largest steamers receive and discharge their cargoes.

The entire cost of this improvement was estimated at \$135,000.

The following appropriations have been made for this work, viz :

By act of August 5, 1886.....	\$30,000
By act of August 11, 1888.....	40,000

Under the first appropriation a part of the channel lying along the front of the wharves was dredged, giving an area of 1,600 feet in length and 400 feet wide, having the full depth of 29 feet.

In the last fiscal year the amount of material measured in situ which has been dredged from the channel and dumped outside is 77,792.4 cubic yards soft material, and 61,265.5 cubic yards of hard pan and hard sand.

This has connected the area first dredged with deep water of the anchorage by a dredged cut 227 feet wide, 2,800 feet long, and 29 feet deep.

The entire expenditures on the work have been \$67,245.63.

The amount expended in last fiscal year is \$37,253.29.

In September, 1888, proposals for dredging were invited by public advertisement.

The lowest bid was from Messrs. Moore & Wright, of Portland, Me., and the contract was awarded to them.

Dredging under the contract was commenced late in October and continued until December, when operations were suspended for the winter. Active operations were resumed April 3, and continued to the close of the fiscal year, at which time dredging under the contract was practically completed, though there still remained a few shoal places to be dredged.

By exercising some care the largest steamers can now enter and leave the harbor or lie alongside the Atlantic wharves at any ordinary low stage of the tide.

During the last year a small shoal was removed from the harbor near the wharf used by International Steamship Company. The shoal interfered with landings of the steamers at low water.

The completion of the project will cause a great improvement to the harbor as a terminal point for transatlantic steamers and large vessels.

It is proposed to apply funds which may be appropriated to the completion of the project.

Portland is an important point both from the commercial and military point of view.

The harbor is defended by Forts Preble, Gorges, Scammel, and a battery at Portland Head.

There is a light-house on the breakwater, and a second at Portland Head, 3 miles distant from the city.

The harbor is in the collection district of Portland and Falmouth, Me., of which Portland is the port of entry.

Money statement.

July 1, 1888, amount available.....	\$7.66
Amount appropriated by act of August 11, 1888.....	40,000.00
	<hr/> 40,007.66
July 1, 1889, amount expended during fiscal year, exclusive of	
liabilities outstanding July 1, 1888.....	\$26,620.80
July 1, 1889, outstanding liabilities.....	10,632.49
	<hr/> 37,253.29
July 1, 1889, balance available.....	<hr/> 2,754.37
{ Amount (estimated) required for completion of existing project.....	65,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	65,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in Portland Harbor, Maine, received October 1, 1888.

No.	Name and address of bidder.	Price per cubic yard measured in situ.	
		Area No. 1.	Area No. 2.
		<i>Cents.</i>	<i>Cents.</i>
1	Robert Hamilton, Chebeague, Me., and Solomon Sawyer, Yarmouth, Me.	.43	.19
2	Moore & Wright, Portland, Me.	.84	.17
3	National Dredging Company, Wilmington, Del.	.39	.16

Abstract of contracts made during the fiscal year ending June 30, 1889, for improvement of Portland Harbor, Maine.

Date of contracts.	Contractors.	Nature of work.	Price per cubic yard measured in situ.
Oct. 31, 1888	Moore & Wright, Portland, Me.	Dredging channel 2,950 feet long, 29 feet deep at mean low water.	*\$0.24 †.17
	* Hard dredging.	† Soft dredging.	

COMMERCIAL STATISTICS.

Arrivals and departures of steam-vessels during the year 1888	727
Arrivals and departures of sailing vessels during the year 1888	2,812
Vessels owned at Portland	337
Tonnage	70,414.24

A 13.

IMPROVEMENT OF CHANNEL IN BACK COVE, PORTLAND, MAINE.

The project for this improvement adopted in 1886 consists in deepening and straightening the channel, so that it shall have a depth of not less than 12 feet at mean low water, and a width of 300 feet following the harbor commissioners' line.

The total estimated cost of the improvement is \$180,000.

The following appropriations have been made for the work, viz:

By act of August 5, 1886	\$26,250.00
By act of August 11, 1888	25,000.00
The total expenditures to June 30, 1889 have been	33,062.10

At the beginning of the fiscal year a contract for dredging the channel was outstanding. Work under the contract was continued until October 30, 1888, when it was completed, by the expenditure of all the funds to which the contract applied.

The total amount of material, measured in situ, removed under this contract was 136,496 cubic yards, of which 86,894 cubic yards were removed subsequent to June 30.

In December, 1888, proposals for continuing the dredging were invited by public advertisement. Only one proposal was received, and it was rejected as too high.

On the 1st of March, 1889, proposals for the dredging were again similarly invited.

On the second opening of proposals somewhat better prices were received and a contract was awarded to the lowest bidder, Mr. Edward Moore, of Portland, Me.

Dredging under this contract commenced June 1, 1889, and at the end of the fiscal year 27,236 cubic yards, measured in scows, had been removed.

The channel thus far dredged is 4,030 feet long, 72 feet wide on the bottom, and 12 feet deep at low water, in addition to the amount removed in June from the upper basin under the latest contract.

All the available funds are to be expended under the present contract.

It would be a very great economy in the ultimate cost of this work to make the appropriations in sums not less than \$50,000.

Small amounts attract little or no competition, so that prices by contract and the contingent expenses are necessarily increased.

The completion of the channel is expected to add to the convenience of receiving and shipping large amounts of coal, lumber, potter's clay, and miscellaneous articles, and it will cause greatly reduced freights, especially in the interest of suburban villages, towards which the growth of the city is tending.

With the appropriations which may be made available for the purpose it is proposed to continue the improvement by completing the first cuts the entire length, and then to widen the channel by successive cuts until the entire width is obtained.

Back Cove is a part of Portland Harbor and is therefore in the same collection district, and is defended by the same forts, and is near the same light-houses as are given for Portland Harbor.

The commercial statistics can not at present be separated from those of the principal harbor, with which they are therefore included.

Money statement.

July 1, 1888, amount available.....	\$15,521.61
Amount appropriated by act of August 11, 1888.....	25,000.00
	<hr/> 40,521.61
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$20,796.79
July 1, 1889, outstanding liabilities.....	1,536.92
July 1, 1889, amount covered by existing contracts.....	16,343.96
	<hr/> 38,677.67
July 1, 1889, balance available.....	1,843.94
{ Amount (estimated) required for completion of existing project.....	128,750.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	50,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in channel in Back Cove, Portland, Me., received January 10, 1889.

No.	Name and address of bidder.	Price per cubic yard measured in scow.
1	Edward Moore, Portland, Mo.....	<i>Cents.</i> 25

Rejected as too high.

Abstract of proposals for dredging in channel in Back Cove, Portland, Me., received March 19, 1889.

No.	Name and address of bidder.	Price per cubic yard measured in scow.
		<i>Cents.</i>
1	Bay State Dredging Company, Boston, Mass.....	36
2	Thomas Symonds, Leominster, Mass.....	23
3	Edward Moore, Portland, Me.....	22

Contract awarded to Edward Moore, of Portland, Me. Date of contract, April 8, 1889.

A 14.

BREAKWATER AT MOUTH OF SACO RIVER, MAINE.

The present project for this improvement consists in repairing and completing the old breakwater so that it shall have a height of 15 feet above low water, and a width of 12 feet on top.

The original estimated cost of the entire work was \$72,000.

The following appropriations have been made for this improvement :

By act of July 5, 1884	\$15,000.00
By act of August 5, 1886	12,500.00
By act of August 11, 1888	12,500.00
Total.....	40,000.00
Total expenditure to June 30, 1889.....	27,856.14

At the beginning of the last fiscal year no funds were available for prosecuting the work. The appropriation of August 11 became available so late in the season that all the formalities of a contract could not be concluded in time to resume work upon the breakwater before the spring of 1889.

In January, 1889, proposals for placing stone upon the breakwater were invited by public advertisement. The lowest bidder was Mr. George Willett Andrews, of Biddeford, Me., and to him the contract was awarded.

But little progress has been made thus far, the amount placed upon the breakwater being but 104 tons.

All the available funds will be expended upon this contract during the ensuing year.

The repair of the breakwater does not in any way affect the currents over the bar, and it has not thus far caused any appreciable benefit to the channel. The channel over the bar varies in depth from time to time, but there is no reliable depth exceeding $3\frac{1}{2}$ feet at mean low water.

To cause and maintain any greater depth a jetty is required on the opposite side of the channel as shown on map opposite page 458, Report of Chief of Engineers for 1887. Funds available for the breakwater are not available for the jetty.

Money statement.

July 1, 1888, amount available.....	\$1.48
Amount appropriated by act of August 11, 1888.....	12,500.00
	<hr/> 12,501.48
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$348.57
July 1, 1889, outstanding liabilities.....	9.05
July 1, 1889, amount covered by existing contracts.....	11,161.00
	<hr/> 11,518.62
July 1, 1889, balance available.....	<hr/> 982.86
<hr/>	
(Amount (estimated) required for completion of existing project.....	30,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1891	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for furnishing and placing stone on the breakwater at the mouth of Saco River, Maine, received February 12, 1889.

No.	Name and address of bidder.	Price per ton of 2,000 pounds.	
		First class.	Second class.
1	Thomas A. Rowe, Boston, Mass.....	\$1.49	\$1.49
2	Joseph F. Curitt and Alfred E. Hamilton, Chebeague, Me.....	1.49	1.49
3	John A. Hamilton and Rufus A. Soule, Chebeague, Me.....	1.37	1.37
4	Fred. L. Andrews, Biddeford, Me.....	1.03	1.03
5	George Willett Andrews, Biddeford, Me.....	.87	.87
6	Horace M. Sargent, Portland, Me., and Isaac H. Webber, Chebeague, Me.....	1.42	1.38
7	C. H. Bragdon & Son, Biddeford, Me.....	1.47	1.47

The contract was awarded to George Willett Andrews, of Biddeford, Me. Date of contract, March 1, 1889.

A 15.**IMPROVEMENT OF SACO RIVER, MAINE.**

A project for improving the Saco River was adopted in 1886, based upon a report and plans submitted by Colonel Blunt in compliance with requirements of river and harbor act of July 5, 1884.

This did not include the works necessary for obtaining deeper water over the bar, as they had been estimated for in report upon the breakwater.

The breakwater was originally built from appropriations for improving Saco River. Separate appropriations having recently been made for the breakwater, it has been necessary to separate the two projects, making one for the breakwater and the second for Saco River, including everything except the breakwater. This division of projects has hitherto worked much confusion, and has delayed the prosecution of work where it has been most required.

The project for improving the river has therefore been entirely revised. The items and estimate complete as revised, are as follows:

1. For jetty opposite breakwater, 65,000 tons of stone, at \$1.....	\$65,000
2. Ledge and shoals at Little Islands.....	8,500
3. Wing dam and training-wall at Little Islands, 7,000 tons stone, at \$1..	7,000
4. Jetty at Chandler's Point, 8,000 tons of stone, at \$1.....	8,000
5. Jetty at Spindle, below Cow Island, 2,500 tons stone, at \$1.....	2,500
6. Jetty and training wall opposite Spindle, 11,000 tons stone, at \$1.....	\$11,000
Brush fascines for same.....	500
	<hr/>
	11,500
7. Wing-dam at Cow Island, 6,700 tons stone, at \$1.....	6,700
8. Dredging between upper narrows and wharves, 128,000 cubic yards, in scows, at 25 cents.....	32,000
Contingencies of engineering, say.....	13,800
	<hr/>
Total	155,000

Of the above works, item No. 2 has been completed.

Item No. 3 will be completed the present season, and No. 4 will be commenced.

Nearly 17,000 cubic yards of material have been dredged under item No. 8.

Appropriations as follows have been made for this improvement.

By act of August 5, 1886.....	\$12,500.00
By act of August 11, 1888.....	10,000.00
	<hr/>
Total.....	22,500.00
Expended to June 30, 1889.....	17,513.43

At the beginning of the fiscal year work had been suspended owing to the lack of funds.

In September, 1888, the officer in charge of the work recommended that the funds appropriated by act of August 11, 1888, be expended in commencing a jetty opposite to the breakwater for the purpose of increasing the depth of water over the bar.

This recommendation was disapproved of by reason of a construction which had previously been placed upon the law.

A new project was therefore submitted for expending the appropriation upon the jetty and training-wall at Little Islands, and the dam and protection at Cow Island.

In March, 1889, proposals for delivering and placing the stone in these contraction works were invited by public advertisement.

The lowest bidder was Mr. George Willett Andrews, of Biddeford, Me., and the contract was awarded to him.

Work under the contract was commenced early in May, 1889, and in June 4,641 tons of stone had been delivered in the training-wall at Little Islands.

The available funds will be expended upon the works mentioned during the present season.

The works, while giving a greater depth of water, can not afford any substantial benefit, so long as the depth of water over the bar at the mouth is no greater than the original depths at these points in the river.

At present the river is navigated to a very considerable extent, but the reliable depths over the bar are no greater than the shoal places in the river above.

In order to accomplish the most substantial benefit to the navigation of the river, make the work hitherto done of some real advantage, and at the same time to do the work economically and reap the results at once instead of in the indefinite future, the jetty on south side of chan-

nel, which has been unavoidably deferred, should be built under one appropriation, and in a single year. The appropriation asked is for this purpose. The interests of navigation would be much better served to have the appropriation for the breakwater added to that for the river and have but one project, because both projects are for the improvement of the same river over a total length of but 5 miles.

Another advantage of doing this work rapidly is that the mouth of the river may be made a very valuable refuge.

Upon this subject I may refer to the report of Colonel Blunt upon Wood Island Harbor, submitted in compliance with requirement of the river and harbor act of July 5, 1884. Wood Island is almost directly opposite the mouth of the Saco River, and is less than 2 miles distant from the breakwater.

The report mentioned recommended the improvement of Wood Island Harbor as a refuge, estimating the expense at \$547,000.

The mouth of the river, if properly improved, will not only be a benefit to the commerce of the river, but will largely obviate any necessity for a refuge at Wood Island.

The Saco River is in the collection district of Saco, Me., of which Saco is the port of entry. Nearest light-house, Wood Island.

Money statement.

July 1, 1888, amount available.....	\$63. 63
Amount appropriated by act of August 11, 1888.....	10, 000. 00
	10, 063. 63
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1889.....	\$3, 028. 41
July 1, 1889, outstanding liabilities.....	2, 048. 70
July 1, 1889, amount covered by existing contracts.....	4, 683. 87
	9, 760. 98
July 1, 1889, balance available.....	302. 70
{ Amount (estimated) required for completion of existing project.....	132, 500. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891.....	65, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for stone jetties, training-wall, and bank protection, Saco River, Maine, received April 4, 1889.

No.	Name and address of bidder.	Price per ton.
1	Charles H. Bragdon and William H. H. Bragdon, Biddeford, Me.	\$1. 10
2	Fred. L. Andrews, Biddeford, Me.	1. 11
3	Horace M. Sargent, Portland, Me., and Isaac H. Webber, Chebeague, Me.	1. 07
4	George Willett Andrews, Biddeford, Me. ....	. 93

A contract was entered into with George Willett Andrews, of Biddeford, Me., April 19, 1889.

COMMERCIAL STATISTICS.

The following statistics, for the year 1888, were kindly furnished by G. N. Weymouth, secretary of the Biddeford Board of Trade:

Number of arrivals of sailing-vessels	192
Exports:	
Bricks	2, 000, 000

Imports:

Coal.....	tons..	37,943
Iron.....	do..	2,597
Sand, gravel, ashes, etc.....	do..	1,200
Lumber.....	feet..	1,000,000
Cotton.....	bales..	1,500
Lime and cement.....	casks..	9,000

A 16.

IMPROVEMENT OF KENNEBUNK RIVER, MAINE.

Appropriations for this river have been made in fourteen small amounts, the first being in act of March 2, 1829. Total of fourteen appropriations, \$65,175. On the first of July, 1888, there remained a balance of \$99.42.

During the last fiscal year some small expenses have been incurred in making a chart of the river and obtaining deeds to lands belonging to the United States.

Total expenditure in year, \$22.80.

Under the river and harbor acts of August 11, 1888, an examination of the river has been made, and a preliminary report was submitted January 7, 1888.

A final report and estimate is to be submitted at an early day.

Money statement.

July 1, 1888, amount available.....	\$99.42
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	22.80
July 1, 1889, balance available.....	76.62

A 17.

IMPROVEMENT OF HARBOR AT YORK, MAINE.

The project for this work consists in widening the channel in three places to obtain a depth of 10 feet at mean low water, with room for the movement of vessels.

The following appropriations have been made for the improvement:

By act of August 5, 1886.....	\$15,000.00
By act of August 11, 1888.....	10,000.00
Total.....	25,000.00
Expenditures to June 30, 1889.....	13,221.83

At the commencement of the fiscal year the balance of the available funds was too small for any work of improvement.

The appropriation of August 11, 1888, became available too late in the season to do any work under contract before the late autumn and winter months, when such operations can not be carried on to advantage.

In December, 1888, proposals for removing the ledge and overlying materials at Stage Neck were invited by public advertisement. The lowest bid received was considered too high, and the proposals were rejected.

In March, 1889, proposals were again invited by advertisement.

The lowest bidder was Mr. Thomas Symonds, of Leominster, Mass., and a contract has been entered into with him to remove the ledge as far as available funds permit. The funds are not sufficient to accomplish the entire removal of the ledge, but the amount removed will greatly benefit the entrance to the harbor.

Owing to the difficulty of measuring the ledge in situ, it being covered with gravel and boulders, the measurements by which payments are to be made by contract are to be in scows; this will exceed the situ measurement approximately 30 per cent. Situ measurements include only the solid material within the theoretical plans to which it is to be removed, but measurements in scows include all voids and excess.

The estimated cost of the improvement as amended is \$44,000. The balance required to complete the improvement is therefore \$19,000. It would be great economy to make this in one appropriation rather than more.

Funds which may be appropriated the ensuing year are to be expended in completing the removal of ledge at Stage Neck, and in dredging two points above according to the project.

Money statement.

July 1, 1888, amount available.....	\$2, 071. 89
Amount appropriated by act of August 11, 1888.....	10, 000, 00
	12, 071. 89
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$293. 72
July 1, 1889, amount covered by existing contracts.....	10, 800. 00
	11, 093. 72
July 1, 1889, balance available.....	378. 17
{ Amount (estimated) required for completion of existing project.....	19, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	19, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging and removing ledge in York Harbor, Maine, opened January 10, 1889.

No.	Name and address of bidder.	Price per cubic yard measured in scows.	
		Ledge.	Overlying material.
1	Boynnton Bros., Boston, Mass.....	\$17. 00	\$0. 80
2	Thomas Symonds, Leominster, Mass.....	15. 00	. 75
3	George W. Townsend, Boston, Mass.....	13. 50	1. 00

All bids were rejected as too high.

Abstract of proposals for dredging and removing ledge in York Harbor, Maine, opened March 19, 1889.

No.	Name and address of bidder.	Price per cubic yard measured in scows.	
		Ledge.	Overlying material.
1	O. J. Jennings, Fulton, N. Y	*\$11.00	*75
2	George W. Townsend, Boston, Mass	†13.00	150
3	Thomas Symonds, Leominster, Mass	10.97	60
		10.00	50

* Stage Neck.

† Isolated.

A contract was entered into with Thomas Symonds, of Leominster, Mass., April 22, 1889.

A 18.

IMPROVEMENT OF HARBOR AT PORTSMOUTH, NEW HAMPSHIRE.

The project for improving this harbor was fully described in last Annual Report.

The only part remaining to complete the work as designed is the removal of part of the point of Badger's Island to a depth of 10 feet at mean low water.

Later observations have led to the conclusion that it is not advisable to remove the ledge to so small a depth. The expense of removing this rock to a greater depth is considered to be entirely incommensurate with the benefits to be received. The project is therefore considered as completed.

A contract has been made for the expenditure of available funds in removing the point of the ledge to 18 feet for reasons quite fully set forth in the last Annual Report.

The original estimated cost of the entire improvement was \$150,000.

The following appropriations have been made for this work, viz :

By act of March 3, 1879	\$10,000.00
By act of June 14, 1880	25,000.00
By act of March 3, 1881	20,000.00
By act of August 2, 1882	17,000.00
By act of July 5, 1884	20,000.00
By act of August 5, 1886	15,000.00
By act of August 11, 1888	15,000.00
Total	122,000.00
Expended to June 30, 1889	107,679.14

Money statement.

July 1, 1888, amount available	\$395.06
Amount appropriated by act of August 11, 1888	15,000.00
	15,395.06
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$1,074.20
July 1, 1889, amount covered by existing contracts	13,511.06
	14,585.26
July 1, 1889, balance available	809.80

540 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

Abstract of proposals for removing ledge in Portsmouth Harbor, New Hampshire, received February 12, 1889.

No.	Name and address of bidder.	Price per cubic yard in situ.
1	Thomas Symonds, Leominster, Mass	\$15.00
2	Thomas A. Rowe, Boston, Mass	24.75
3	George W. Townsend, Boston, Mass	17.90
4	Solon S. Andrews, Biddeford, Me	17.45
5	O. J. Jennings, Fulton, N. Y.	11.00

A contract was entered into with O. J. Jennings, of Fulton, N. Y., March 25, 1889.

COMMERCIAL STATISTICS.

Number of arrivals of sailing vessels, exclusive of fishing vessels, pleasure crafts or vessels which put in for refuge..... 671
 Number of arrivals of steamers, exclusive of tow-boats and excursion steamers .. 39

RECEIPTS BY WATER.

Coal	tons..	310,909	Salt	hogsheads..	1,500
Lumber	feet..	3,850,000	Salt	boxes..	15,000
Railroad ties.....		200,000	Potatoes	bushels..	2,000
Cement.....	barrels..	42,550	Oysters	do..	5,950
Lime	do..	30,000	Iron	tons..	1,250
Plaster	do..	6,000	Water pipe	do..	1,696
Wood	cords..	600	Sand	do..	1,620
Phosphate	tons..	300	Stone	do..	745
Ashes.....	do..	175	Paving	do..	312
Asphalt.....	do..	100	Miscellaneous merchandise..do...		1,500

EXPORTS.

Brick.....		15,100,000
Number of vessels owned.....		63
Tonnage.....		10,198.87
Number of steam-boat lines.....		4
Number of tug-boat lines.....		5
Number of irregular tow-boats arriving for tows.....		50

The above statistics have been courteously furnished by Col. William H. Sise, president of the Portsmouth Board of Trade.

The collector of customs reports the following :

Collections for the district during 1888.....	\$5,871.82
Value of importations	\$47,372.39
Foreign entrances.....	53
Tonnage.....	10,784
Foreign clearances.....	60
Tonnage.....	11,390

A 19.

IMPROVEMENT OF BELLAMY RIVER, NEW HAMPSHIRE.

This is a new work, the project for which is based upon a survey made in compliance with requirements of the river and harbor act of August 5, 1886.

The river to the head of navigation is a tidal branch of Great Bay, which opens into the Piscataqua River at Dover Point, 4 miles above the bridge at Portsmouth, N. H.

At low water the channel of the river was too shallow for any navigation, save for a short distance. The entire distance over which improvements are required is 13,300 feet, a little more than 2½ miles. The project of improvement consists simply in dredging the present natural channel sufficiently to give a mean low-water depth of 5 feet, and a width of 50 feet on the bottom. The depth at mean high water will be nearly 12 feet.

The improvement commences at a point about 2 miles from the Piscataqua River.

In December, 1888, proposals for dredging were invited by public advertisement. Bids were opened January 10, 1889. The only proposal received was rejected as too high. In March, 1889, proposals for the dredging were similarly invited, and a contract for dredging, as far as available funds permit, has been made with Mr. Thomas Symonds, of Leominster, Mass., who was the lowest bidder. Dredging was commenced May 1, 1889, and on the 30th of June the dredging had been completed for a distance somewhat more than 3,500 feet. To do this required the removal of 22,700 cubic yards of material.

The benefits to be derived from this small improvement are mainly in the shipment of bricks, of which a large amount of the finest quality in New England are manufactured on and near the banks of this water. An increased manufacture is expected to result, and the expense of shipment will be decreased by about 50 cents per 1,000 bricks. A few other shipments will result from the improvement, and coal and other supplies will be brought in at a considerable saving of expense. It is proposed to expend the appropriation for which an estimate is submitted in continuing the improvement by dredging.

Money statement.

Amount appropriated by act of August 11, 1888.....	\$10,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$4,757.01
July 1, 1889, outstanding liabilities.....	448.32
July 1, 1889, amount covered by existing contracts.....	4,516.75
	<hr/> 9,722.08
July 1, 1889, balance available.....	<hr/> 277.92
<hr/>	
{ Amount (estimated) required for completion of existing project.....	18,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	18,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in Bellamy River, New Hampshire, received January 11, 1889.

No.	Name and address of bidder.	Price per cubic yard measured in scow.
1	Thomas Symonds, Leominster, Mass	<i>Cents.</i> 35

Rejected, being deemed too high.

542 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

Abstract of proposals for dredging in Bellamy River, New Hampshire, received March 19, 1889.

No.	Name and address of bidder.	Price per cubic yard measured in scow.
		<i>Cents.</i>
1	Hamilton & Sawyer, Chebeague, Me	24
2	Thomas Symonds, Leominster, Mass	19
3	Bay State Dredging Company, Boston, Mass	23

Contract awarded to Thomas Symonds, of Leominster, Mass. Date of contract, April 22, 1888.

A 20.

IMPROVEMENT OF COCHECO RIVER, NEW HAMPSHIRE.

A description of this river was given in annual report for 1887, and a map showed its connections with the Piscataqua River (Report Chief of Engineers 1887, page 548.)

The project for improving the river, to give a mean low-water depth of 5 feet or nearly 12 feet at mean high water, has been completed. The channel in the portions which were improved is 50 feet wide on the bottom.

The estimated cost of the improvement was \$47,000.

The following appropriations have been made:

By act of July 5, 1884	\$28,000.00
By act of August 5, 1886	10,000.00
By act of August 11, 1888	9,000.00
Total	47,000.00

Total expended to June 30, 1889..... 46,709.73

At the date of last annual report work was suspended for lack of funds.

The amount required to complete the improvement being small, and it being urgent that the dredging should be completed before winter, which could not be done if a contract were awarded after the delay of advertising, etc., Mr. Thomas Symonds, of Leominster, was employed to do the work under a contract without a public competition, at 45 cents per cubic yard for sand and logs, and \$2.50 per cubic yard for hardpan.

The autumn rains caused a land-slide to fill the channel at Alley's Point to such an extent that vessels could not pass.

A dredge was therefore employed three days to clear the channel. In this work 672 cubic yards of clay were dredged at a cost of a little less than 45 cents per yard.

The bank was in such condition that unless the top were removed it would slide and again fill the channel. A small party was therefore employed from December 20 until April 15 in cutting away the bank and removing 4,780 cubic yards of clay in carts. In this manner a slope was cut in the bank leaving a broad berme at a level of 5 feet above high water.

The improvements thus far have been a vast benefit to the naviga-

tion. In fact, all the commerce by water, which is still increasing, has been a result of the improvement to the river channel.

The river and harbor act of August 11, 1888, required a survey or examination of the Cocheco River.

The preliminary examination was made in November, 1888, and a report was submitted to the Chief of Engineers January 3, 1889.

A survey of the river will be made during the ensuing summer, and a plan of necessary improvements, and estimate of cost will then be submitted.

It is proposed to expend the small available balance of funds in making the survey.

Money statement.

July 1, 1888, amount available.....	\$317.89
Amount appropriated by act of August 11, 1888.....	9,000.00
	<hr/>
	9,317.89
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	9,027.61
	<hr/>
July 1, 1889, balance available	290.28

A 21.

HARBOR OF REFUGE AT LITTLE HARBOR, NEW HAMPSHIRE.

The original project for this improvement consisted in dredging a channel 100 feet wide and 9 feet deep at low water across the bar, widening the anchorage, and constructing a small breakwater on the ledge at Jerry's Point.

The enlarged plan indicated in river and harbor act of August 11, 1888, consists of two small breakwaters at the entrance to the harbor, and dredging the channel and enlarged anchorage to a depth of 12 feet at low water.

The breakwaters are estimated to require 56,000 tons of stone; the total of dredging was estimated to be 572,000 cubic yards in situ. By an oversight, a portion of the project previously approved was not included in the estimate for the amount of dredging on enlarged plan. This increases the total situ measurement to 620,000 cubic yards. The prices thus far received in proposals for dredging have been considerably in excess of the estimated cost. It is, however, probable that after the breakwaters have been constructed the cost of dredging the remaining part of the basin will be reduced. For this reason no revision of the estimate will now be made other than to include the small area which had been omitted.

It is probable that sand will be found to wash into the basin somewhat from the adjacent flats, so as to ultimately cause a small percentage of increase to the amount of dredging. Such a sliding in has already been found in the narrow channel dredged near the end of the Frost Point breakwater. It is probable, however, that the contraction of the entrance will cause an increased tidal current sufficient to maintain the required depth at that point.

Little Harbor is a part of the mouth of the Piscataqua River, which forms the harbor of Portsmouth, and the original project for its improvement was as an adjunct to Portsmouth Harbor.

The tidal currents in the main channel of the Piscataqua River are so strong that a vessel can make no headway against them except with a strong fair wind.

The winds and storms which cause danger on that part of the coast are generally from directions north of east, and in such winds it is impossible for a sailing vessel to reach a sheltered anchorage in the river during an ebb tide. Little Harbor, the other mouth of the river, has far less strength of tidal currents, and the direction of entrance is such that after sufficient depth has been obtained vessels can readily enter at all times when a shelter is required.

The following is the entire estimate of cost for the improvement on the enlarged plan :

For breakwaters, 56,000 tons of stone, at \$1.25.....	\$70,000
For dredging 572,000 cubic yards situ, at 25 cents	143,000
Contingencies of engineering, etc.....	22,000
Total	235,000

The following appropriations have been made for this improvement :

By act of August 5, 1886.....	\$10,000.00
By act of August 11, 1888.....	20,000.00
Total	30,000.00
Expenditure to June 30, 1889.....	21,325.99

At the beginning of the last fiscal year the previous appropriation had been expended, and work was suspended.

In September, 1888, proposals for dredging were invited by public advertisement.

The lowest bid received was from the New England Dredging Company, of Boston, Mass. A contract was therefore made with this company for the expenditure of available funds in dredging.

Dredging under this contract was commenced May 16, 1889. On the 30th of June there had been removed from the channel 37,479 cubic yards. This has resulted in extending the channel of 9 feet depth, which was dredged under the former contract, to the anchorage, and in several cuts to widen the same.

This is one of the dangerous points on the coast. A life-saving station has been established on the Little Harbor side of Jerry's Point.

The superintendent of the first district of life-saving service has furnished me with a list of nine vessels totally wrecked in the last ten years in trying to get into Portsmouth Harbor, all of which could have easily put into Little Harbor had there been sufficient depth of water.

In addition to the wrecks mentioned, the keeper of the Jerry's Point life-saving station has furnished a list of thirty-seven vessels known to have been wrecked on the shore between Little Harbor and Rye Beach, a distance of less than four statute miles. The dates of the wrecks are not given. The list is taken from records in the possession of Capt. Charles Salter, of Portsmouth, N. H.

Little Harbor is in the collection district of Portsmouth, N. H. The nearest light-house is at Fort Constitution, on Goat Island. Whale's Back Light is almost equally near on the opposite side of the channel. The nearest fortifications are the defenses of Portsmouth Harbor and navy-yard.

Money statement.

July 1, 1888, amount available	\$92.24
Amount appropriated by act of August 11, 1888	20,000.00
	20,092.24
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$3,893.68
July 1, 1889, outstanding liabilities	7,524.55
July 1, 1889, amount covered by existing contracts	7,505.88
	18,924.11
July 1, 1889, balance available	1,168.13
Amount (estimated) required for completion of existing project	205,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1891	75,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

List of vessels wrecked near Little Harbor during the past ten years.

No.	Date.	Name of vessel.	Rig.	Cargo.	Remarks.
1	Apr., 1879	L. S. Barnes	Schooner	Hay	A total loss.
2	Apr., 1880	Name not known	do	Slate and wood	Do.
3	Mar., 1884	do	do	Hay	Do.
4	Oct., 1884	do	do	Coal	Do.
5	Oct., 1885	Express	do	do	Do.
6	Oct., 1887	Mystery	do	Not known	Do.
7	Sept. 6, 1888	Valparaiso	do	Assorted	Crew taken off by Jerry's Point life-saving crew.
8	Sept. 6, 1888	Name not known	do	Not known	A total loss.
9	Nov. 26, 1888	Oliver Dyer	do	Coal	Do.

List of vessels wrecked between Little Harbor and Eye Beach.

1. Ship Granville.	20. Schooner Gov. Bontelle,
2. Ship Emerald.	21. Schooner Rival.
3. Ship Brunette.	22. Schooner Gipsey.
4. Schooner Roman.	23. Schooner Reunion.
5. Schooner Willie Lee.	24. Schooner Fanny Fern.
6. Schooner Tabatha.	25. Schooner Moonlight.
7. Schooner Sophronia.	26. Schooner Woodbury.
8. Schooner Solomon Francis.	27. Schooner Johnny.
9. Schooner Betsey.	28. Schooner Eliza Jane.
10. Schooner William Wallace.	29. Schooner Gilman Berry.
11. Schooner Erie.	30. Schooner Eddie F. Frost.
12. Schooner James Clarke.	31. Schooner Elizabeth.
13. Schooner Clio.	32. Schooner Annie M. Ellem
14. Schooner Water Sprite.	33. Schooner Susanna Rand.
15. Schooner Tappan.	34. Schooner Elva.
16. Schooner Genl. Taylor.	35. Schooner Pulaski.
17. Schooner Java.	36. Schooner Patriot.
18. Schooner Thomaston.	37. Schooner Pocahontas.
19. Schooner Nightingale.	

Abstract of proposals for dredging in Little Harbor, New Hampshire, received October 6, 1888.

No.	Name and address of bidder.	Price per cubic yard in scow.
		Cents.
1	Robert Hamilton, Chebeague, Me., and Solomon Sawyer, Yarmouth, Me.	29
2	New England Dredging Company, Boston, Mass.	28
3	National Dredging Company, Wilmington, Del.	28½

A contract was entered into with the New England Dredging Company, of Boston, Mass., October 23, 1888.

A 22.

PRELIMINARY EXAMINATION OF HARBOR AND CHANNEL AT PEMBROKE, MAINE.

UNITED STATES ENGINEER OFFICE,
Portland, Me., January 1, 1889.

SIR: I have the honor to submit the following report of a preliminary examination of the harbor and channel at Pembroke, Me.

In compliance with instructions from the Chief of Engineers in letters dated August 22, 1888, and September 29, 1888, I visited Pembroke on the 13th of November, 1888.

I examined the harbor and channel at the stage of extreme low water, the most favorable for the purpose.

The township of Pembroke is in the southeastern part of the State; it is separated from Passamaquoddy Bay and the Atlantic coast by single townships only.

The southern portion of Pembroke is bordered by Lubec Bay and its various branches, one of which with its tributary stream flowing nearly south divides the township into two parts. The stream is known as the Pennamaquan River, and the tidal branch into which it flows is the Pennamaquan Bay. The head of Pennamaquan Bay is divided into two branches, east and west, which form the harbor of Pembroke, though the two villages situated upon the branches are known as Pembroke and West Pembroke.

The population of the township in 1880 was 2,324 and it has probably not increased since that time. For some years quite extensive iron works were carried on at Pembroke, but these have declined and as far as practicable the plant has been removed.

A large number of vessels have been built at Pembroke, but this business has also declined with no prospect of recovery.

Some repairing of vessels is still done at Pembroke. When I visited the harbor a vessel of about 250 tons lay upon the sloping, gravelly shore, where it had been left by the tide, and a small crew of men was making repairs to the hull. The mean tidal range is about 18 feet, and this of itself would give an ample depth at high water for any possible business or traffic in sailing vessels. There seems to be but very little business requiring large vessels to go to the wharves at Pembroke, and those which visit the place, freighting coal or other supplies, and carrying out canned fish, lumber, or other freights, have good facilities at high water.

Several masters of vessels with whom I conversed, gave it as their opinion that the rate of freights would not be in any way affected by improving the low-water channel. So far as I could ascertain the benefit to be expected from improving the channel is the probability of afterwards being able to procure a small steamer to run from Pembroke to Eastport in connection with the steamers of the International Line.

In the bringing in of fish for canning, and of miscellaneous small freights, as well as the carrying of passengers, such a steamer would doubtless be a very great benefit and convenience.

It would not, however, enter into the general commerce of the country to any appreciable extent.

The removal of shoals which now obstruct the channel at low water would save a delay of two to four hours for about one fourth of the time during eight months annually. During four months of the year the steamer would not run, owing to ice, etc.; in the remainder of the time

delays would occur only when the hour for the trip coincided nearly with that of low water.

While other points were brought to my notice, they did not seem to me to materially affect the question, and I could hardly fail to conclude as I did that the harbor and channel of Pembroke are not worthy of improvement.

Very respectfully, your obedient servant,

JARED A. SMITH,
Lieut. Col., Corps of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

A 23.

PRELIMINARY EXAMINATION OF MONHEGAN ISLAND HARBOR, MAINE.

UNITED STATES ENGINEER OFFICE,
Portland, Me., December 27, 1888.

SIR: I have the honor to submit the following report of a preliminary examination of Monhegan Island Harbor, Maine.

In compliance with instructions from the Chief of Engineers I visited Monhegan Island and the harbor on the 23d of October, 1888, and made such observation and inquiries as were practicable. The information thus obtained has been supplemented by correspondence.

Monhegan Island is about 8 miles outside of the general line of the coast of Maine, and is somewhat more than 20 miles east of the mouth of Kennebec River. The island is $1\frac{1}{2}$ miles long, and a little more than half a mile wide. The shores of the island are generally abrupt and are of solid rock.

On the east of Monhegan Island, at a distance of about 650 feet between shores, is a small island known as Manana, with very precipitous shores of solid ledge; it is about three eighths of a mile long. The channel between the two islands is partially closed on the north by two small islands of rock. The irregularities of the shore on the Monhegan side permit of a deposit of sand and small stone, which forms an anchorage for small fishing boats, but the water in the middle of the harbor is from 36 to 60 feet deep. The entire population of the islands mentioned was 133 in 1880, but it is probably less at present. The business interest of the place centers entirely in fishing, which is all carried on with small boats locally known as "reach boats." The fishing boats are from about 17 to 22 feet long. I saw the entire fleet of from 50 to 60 at anchor, and judged that an average of \$25 apiece would cover their value, making a total of, say, \$1,500.

In storms some of these "reach boats" get adrift and are wrecked or lost.

The harbor is too small to be made of any possible use as a refuge for general commerce; its shores are so steep and rocky, and the place is so narrow, that no commander of a vessel of any size would consider the question of entering so long as he had any means of keeping afloat outside.

In summer a small sail boat carrying the mail goes to the island twice per week, and small excursion steamers occasionally run to the island in pleasant weather. A schooner of 21 tons also goes over about once in two weeks to get the fish which has been caught and salted.

It will be readily seen that any expenditure upon the harbor would benefit the anchorage and harbor only for a few boats no larger than ordinary yawls. The saving of other property or of life would not be sensibly affected, nor would rates of freight or insurance be in any way reduced.

To protect the anchorage for the small boats would require a break-water partly across the southern entrance to the harbor, and its expense would vastly exceed any probable benefit to the local business.

I do not therefore consider the harbor worthy of improvement.

Very respectfully, your obedient servant,

JARED A. SMITH,
Lieut. Col., Corps of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

A 24.

PRELIMINARY EXAMINATION OF MEDOMAC RIVER, MAINE.

UNITED STATES ENGINEER OFFICE,
Portland, Me., November 10, 1888.

SIR: In compliance with instructions in Department letter of August 28, 1888, I have the honor to submit the following report of a preliminary examination of the Medomac River, Maine;

On the 10th of October last I visited the river at and near the village of Waldoborough, Me., and the information obtained at that time forms the substance of this report.

The village of Waldoborough is not more than half a mile distant from the line of the Knox and Lincoln Railroad, which connects with the Maine Central system at Bath and extends to Rockland. The river above the village is a small stream, which furnishes a considerable water-power a short distance above tide-water, to which the navigation is limited. The mean range of the tide ascertained by the coast survey is 10 feet. In this connection I refer to Coast Survey chart of Damariscotta and Medomac rivers, Maine. For a distance of 1 mile below the head of tide-water the depth in the channel at mean low water varies from 2 feet to 12 feet. The depth for about one-half of that distance does not exceed 3 feet.

The Coast Survey chart does not indicate any rock, but from Mr. John O. Weston, a licensed pilot, I ascertained that a rocky reef extends across the channel from a point about half a mile below the bridge.

An improvement, to have any practical value, should have not less than 5 feet of depth at mean low water, and of course a greater depth would be better. The tidal currents are too small to enter to any extent as a factor in maintaining a channel, and it does not seem probable that the stream itself will have sufficient force even in freshets to maintain permanently a dredged channel without auxiliary works.

To dredge a channel 75 feet wide and 5 feet deep would require the removal of about 45,000 cubic yards of material, and for the same width and a depth of 6 feet, about 75,000 cubic yards. The material which can be dredged would probably cost about 35 cents per yard, including all contingent expenses. Any ledge of rock which might be found would cost not less than \$10 per cubic yard.

When the presence of rock is taken into consideration it will be seen that the smaller depth would probably cost at least \$25,000, and the greater depth might cost \$40,000 or more.

It is my opinion that the general commerce or business of the country would not be benefited to that extent.

The business of Waldoborough is not extensive, and with the exception of occasional ship-building it does very little to enter into the commerce of the country by water transportation in sailing vessels.

The principal industries requiring such transportation are—

One good granite quarry for paving-stones. One granite and marble yard.

There are from 2,000 to 5,000 cords of wood sent out by vessels each year, but this industry will gradually decline.

Of the general business of the place, most is of a kind to use railroads rather than sailing vessels, and the place has not sufficient business for a steamer.

It is stated that in the last ten years about thirty vessels of 500 to 600 tons measurement have been built at Waldoborough. I saw in one ship-yard the hull of a vessel not yet completed, which is stated to be the largest schooner ever built. The materials entering into the construction of this five-masted schooner have probably cost at least \$500 more for freights than would have been required had the channel been good. But such a vessel is exceptional, and when another of any kind may be built is uncertain.

Three small vessels ply regularly between Waldoborough and Boston, but the present depth at high water is sufficient for their real necessity.

About 1,200 tons of coal are annually brought into the place; with an improved channel the price of this coal would probably be reduced at least 25 cents per ton.

Considering the subject from all the points which I have been able to reach, I conclude that for the present at least the undoubted expense will so far exceed the certainty of benefits that the river is not worthy of improvement.

Very respectfully, your obedient servant,

JARED A. SMITH,
Lieut. Col., Corps of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

A 25.

PRELIMINARY EXAMINATION OF HAMPTON RIVER, NEW HAMPSHIRE.

UNITED STATES ENGINEER OFFICE,
Portland, Me., November 7, 1888.

SIR: In compliance with instructions in Department letter of August 28, 1888, I have the honor to submit the following report of a preliminary examination of Hampton River, New Hampshire:

On the 5th of October last I visited the Hampton River and made such examination and inquiry as the case seemed to require. At a point about a mile from Hampton Village a small wharf was built some years ago, but its use has been limited to the landing of a few small boats navigating the creeks, no outside vessels having visited the place for about nine years.

From the landing mentioned to the mouth of the river by the present channel is approximately 3 miles, and it is about one-half a mile farther to where the water is 18 feet deep outside the bar. This part of the river is in reality but little more than a "salt marsh creek," in which the Coast Survey chart indicates a low-water depth of from 2 to 7 feet. The chart mentioned is, however, upon so small a scale that minute details can not be shown upon it. From the Hampton Landing a canal about one-third of a mile in length was, many years ago, cut across the marsh to shorten and improve the channel. Below the canal the river becomes wide at high water, and one part indicated on chart as Hampton Harbor is about half a mile wide at high water. At the mouth the river is about three-eighths of a mile wide at high water, but the low-water width is not more than half as great.

No exact plans nor estimates for improving the river can be given without a survey made in minute detail, with observations of the currents and the material composing the bed and banks of the stream. It may be assumed, however, that an extensive system of jetties and wing-dams would be required. Over at least half the distance from the landing to the mouth the ordinary scour by currents would not be sufficient to deepen the channel, so that considerable dredging would be necessary. The jetties at the mouth of the river alone would need to be about a mile and a half in total length.

The benefits to be realized would be very small, mainly local, and distributed among two or three small villages, of which Hampton is the largest.

The manufactures of the places are few and of a kind to depend mainly upon railroad transportation, which is at hand. The same may be said of the agricultural productions and miscellaneous industries. The present annual consumption of coal is given as 2,000 tons, with a yearly increase of about 300 tons. There would also be received by water perhaps 300,000 feet of lumber. The saving of freight on the coal would approximate \$1 per ton and on the lumber from \$1 to \$1.50 per 1,000 feet.

Probably some marsh hay might be exported as well as a few miscellaneous shipments. The benefits to be expected from improving the river are so small in comparison to the certainty of large expense that I can not recommend the river as worthy of improvement.

Very respectfully, your obedient servant,

JARED A. SMITH,
Lieut. Col., Corps of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

A 26.

PRELIMINARY EXAMINATION OF HARRISSECKET [HARRASEEKET] RIVER,
MAINE.

UNITED STATES ENGINEER OFFICE,
Portland, Me., January 4, 1889.

SIR: I have the honor to submit the following report of a preliminary examination of the Harrissectet River, Maine:

In compliance with instructions from the Chief of Engineers in letters dated August 28, 1888, and September 29, 1888, I visited Freeport, at the head of tide-water on the river, and made an examination of the

channel over the portion of the river for which the improvement is desired.

The time chosen for the examination was during a stage of low water.

In July, 1881, a survey of the upper part of the river was made under direction of Colonel Thom, and his report appears in the Report of Chief of Engineers, 1882, pages 530 to 532. Part of the information here given is taken from Colonel Thom's report, to which I beg leave to refer.

As far as Freeport Landing the river is in reality a tidal branch of Casco Bay. From Casco Bay proper to Weston's Point, a distance of about 2 miles, the river has a least depth of 10 feet at mean low water. At mean high water the lower part of the river, therefore, has a least depth of 19.4 feet, which is ample for any present or probable requirements.

From Weston's Point to Freeport Landing, a distance of about 4,500 feet, the channel is bordered with wide flats, which are uncovered at low water.

Through the upper half of the distance between the two points the bed of the stream is above the low-water level, so that at Freeport Landing the mean high-water stage gives a depth of only about 7 feet, the mean tide being 9.4 feet.

The channel suggested in Colonel Thom's report, viz, 60 feet wide and 12½ feet deep at mean low water, is hardly sufficient in depth to accommodate the class of vessels which now carry coal and heavy freights to best advantage. A mean high-water depth of 14 feet would be much more suitable at present, and even with that depth the high water during a low run of tides would hardly float a vessel with more than 12 feet draught.

It is very doubtful whether such a channel would remain permanently after being once dredged, unless some works were constructed to concentrate the greater part of the currents within the channel limits. No definite plans for such works have yet been made, so that an exact estimate of cost can not be given.

A rough estimate of expense may be made by assuming that the cost of necessary wing-dams or similar works would be equal to that of dredging, as follows:

65,000 cubic yards dredging at 25 cents.....	\$16,250
Wing-dams, etc., same cost.....	16,250
Contingent expenses.....	3,500
Total	36,000

I have no doubt that this would cover the cost of all work required.

Whether the expense would be fully justified by the certain and probable benefits is a question not easy to determine.

The following are the points in its favor, so far as I have been able to reach them: During the past season 2,000 tons of coal have been laid in for use at Freeport at a cost of at least \$1 per ton more than the same would have cost had freights been practicable by water. The consumption of coal is increasing annually at present prices, because of the scarcity of wood for fuel.

A stone quarry which I visited near the Freeport Landing contains a very superior quality of granite for building, paving, or monumental use. This granite has no superior for any of the purposes named, and the quarry is already in a fine condition to supply a large demand. Large numbers of handsome paving stones lay in the quarry ready for shipment. The granite is also cut into handsome blocks and shafts,

and it not only receives, but retains a very high polish. This stone is now shipped to many points in the West, where the only competition is by railroad freights, but it can not be taken to any of our seaport cities because it has no outlet by water and can not compete with other places which are more favored.

The proprietor of the quarry and stone works informed me that he could at once fill orders for 300,000 paving-stones if he could obtain freights by water, and this would be a low estimate for the annual shipments.

The same principle would obtain in shipping stone for other purposes.

A fine quality of bricks is now made at Freeport, amounting to 700,000 annually. The quantity is now limited to local demands, owing to impossibility of shipping them at rates which enable the manufacturer to deliver them at distant points. There seems to be reason to believe that this industry would be largely increased by improving the channel so that vessels of good size can reach the landing at Freeport.

In the past few years Freeport has developed into an active business place; a large shoe factory and steam mills for grain and lumber have been put in active operation, in addition to the stone and bricks already mentioned.

A daily steamer now runs from Portland to a point about $2\frac{1}{2}$ miles from Freeport, but goes no farther, owing to lack of water at low stages of the tide. With an improved channel the steamer would run to Freeport regularly.

These points seem to me sufficient to make the river worthy of improvement.

Before completing any plan of improvement it would be well to supplement the maps heretofore made by a few additional soundings in the channel and also over the flats where auxiliary works would be required. The expense of this survey is estimated at \$300.

It may be proper to mention that the spelling of the name as found in local records and in the annual register of Maine is "Harraseeket."

Very respectfully, your obedient servant,

JARED A. SMITH,
Lieut. Col. Corps of Engineers.

The CHIEF OF ENGINEERS, U. S. A.



APPENDIX B.

IMPROVEMENT OF RIVERS AND HARBORS IN MASSACHUSETTS.

REPORT OF LIEUTENANT-COLONEL S. M. MANSFIELD, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1889, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

- | | |
|--|---|
| 1. Newburyport Harbor, Massachusetts. | 10. Boston Harbor, Massachusetts. |
| 2. Merrimac River, Massachusetts. | 11. Hingham Harbor, Massachusetts. |
| 3. Powow River, Massachusetts. | 12. Scituate Harbor, Massachusetts. |
| 4. Ipswich River, Massachusetts. | 13. Plymouth Harbor, Massachusetts. |
| 5. Harbor of Refuge, Sandy Bay, Cape Ann, Massachusetts. | 14. Wellfleet Harbor, Massachusetts. |
| 6. Gloucester Harbor, Massachusetts. | 15. Provincetown Harbor, Massachusetts. |
| 7. Manchester Harbor, Massachusetts. | 16. Removal of sunken vessels or craft obstructing or endangering navigation. |
| 8. Lynn Harbor, Massachusetts. | |
| 9. Winthrop Harbor, Massachusetts. | |

EXAMINATIONS.

- | | |
|--|---|
| 17. Malden River, Massachusetts, as to straightening, widening, and deepening the channel. | 19. Goose Point Channel, Plymouth Harbor, Massachusetts, to public wharf at Kingston. |
| 18. Cohasset Harbor, Massachusetts. | 20. Wier River, Massachusetts. |
| | 21. Stage Harbor at Chatham, Massachusetts. |

HARBOR LINES.

22. Establishment of Harbor lines at Boston Harbor, Massachusetts.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., July 8, 1889.

GENERAL: I have the honor to transmit herewith annual reports for the works of river and harbor improvements in my charge for the fiscal year ending June 30, 1889.

I relieved Lieut. Col. G. L. Gillespie, Corps of Engineers, U. S. Army, of the charge of these works on December 20, 1888, in accordance with Special Order, No. 269, Headquarters of the Army, Adjutant-General's Office, November 17, 1888.

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

B 1.

IMPROVEMENT OF HARBOR AT NEWBURYPORT, MASSACHUSETTS.

Newburyport is situated on the south bank, $2\frac{1}{2}$ miles, approximately, from the mouth of the Merrimac River. The river empties into the Atlantic Ocean midway between Cape Ann and Portsmouth, or about 30 miles a little east of north from Boston in a direct line.

The outlet of the river between Plum Island and Salisbury Point is 1,000 feet wide and 30 feet deep at mean low water. At a distance of nearly a mile outside lies a sandy bar, thrown up by wave action, through which, previous to the improvement, a channel, variable in position, direction, and depth, was maintained by the current of the river, increased by the tidal prism in a large interior basin due to a range of tides equaling $7\frac{1}{2}$ feet. For 1,000 feet outward from the gorge towards the crest of the bar the current was able to maintain a channel of navigable width and 18 feet deep at mean low water, and for a further distance of 1,500 feet a channel 12 feet deep. From the 18-foot contour on the inside to the same on the outside the distance was 4,000 feet, and between the 12-foot contours the distance was 3,000 feet.

The depth on the crest of the bar was generally less than 7 feet at mean low water.

The object of the improvement is to create through the outer bar a channel 1,000 feet wide and at least 17 feet deep at mean low water, so that vessels may cross the bar and find a harbor, at any stage of the tide, with as great draught as can reach Newburyport by the river at high tide.

The project submitted September 16, 1880, proposed two converging rubble-stone jetties, their outer ends parallel for 1,000 feet, and about the same distance apart, and the protection of the beach in their vicinity.

This was modified in 1882 so as to provide for the partial closing of Plum Island Basin with a timber dike about 800 feet long and $5\frac{1}{2}$ feet above mean low water.

The direction of the south jetty and the character of the shore protection were modified in 1883. The north jetty from Salisbury Beach is to be 4,000 feet long, approximately, and the south jetty from Plum Island is to be 2,400 feet long, approximately. Both are 15 feet wide on top, which is in a plane 12 feet above mean low water. The two jetties have slopes of 1 on 2 on the sea side, and of 1 on 1 on the harbor side.

A map showing the location of the jetties is published in the Annual Report of the Chief of Engineers for 1885. Their form and dimensions are shown in the Report for 1881. The location and details of construction of the dike are given in the Report for 1883. The estimated cost of the improvement was \$375,000.

The total appropriations for this work to date have been \$232,500. The amount expended to June 30, 1888, was \$207,498.27.

On June 30, 1888, the condition of the improvement was as follows: The north jetty had been completed for a length of 1,930 feet, and in addition 745 feet were partly completed; the south jetty had been completed 1,077 feet, and partly completed for an additional distance of 223 feet, and its shore end strengthened by a durable sand catch.

The dike was completed as far as was prudent at that time for its safety. It was 817 feet long and $5\frac{1}{2}$ feet high above mean low water, except that near its center a weir was left 150 feet long and 2 feet deep at mean low water.

The channel through the bar was at least 200 feet wide and 10.7 feet at mean low water.

On August 24, 1888, a project was submitted for the expenditure of \$25,000 made available for this improvement by the river and harbor act of August 11, 1888. This project proposed to extend the full section of the north jetty 300 feet, approximately, and to refill the sand catch in rear of the south jetty with brush and stone. This project was approved September 7, 1888.

Specifications and advertisement were prepared and issued for the proposed jetty extension, and the bids received were opened October 31, 1888. A copy of the proposals will be found in the annexed table.

On November 20, 1888, a contract was entered into with the Rockport and Pigeon Hill Granite companies for the delivery, in place in the north jetty, of 10,000 tons, more or less, of rubble-stone, at \$1.97 per ton of 2,000 pounds. This contract expires December 31, 1889.

Operations under this contract were commenced during the latter part of January, 1889, but unfavorable weather prevented any material progress until early in May, 1889, after which the progress of the work was satisfactory, and to the close of the year ending June 30, 1889, 5,185 tons had been deposited, thus extending the full section of the north jetty 150 feet, approximately.

At the date of this report the condition of the south jetty, the sand catch, and the dike across Plum Island Basin remains the same as on June 30, 1888.

A survey of the bar and mouth of the river was made in June, 1889; the notes have been plotted, and show that the channel, inside of the outer ends of the jetties, has moved slightly northward, with no material change in its width and depth.

Outside of the ends of the jetties the channel has straightened, moved to the southward, and between the 9 foot contours has decreased in width from 750 feet in 1888 to an average of about 500 feet in 1889. The depth of water on the crest of the bar has lessened since 1888 to 9.2 feet. This narrowing of the channel and decrease in depth is due to the character of the spring freshet. From notes furnished by Mr. Hiram F. Mills, engineer of the Essex Company at Lawrence, Mass., it is known that in 1888, during the months of March, April, and May, 22,588 cubic feet per second of water passed the dam at Lawrence; in 1883, a "dry" year, for the same period, 10,461 cubic feet passed; in 1889 the discharge was 11,588 cubic feet per second.

To complete the improvement an appropriation of \$142,500 will be required, all of which could be expended to advantage during the fiscal year ending June 30, 1891, in the extension of both jetties to their full projected lengths.

The advantages to be derived from the completion of the project are the deepening and widening of the channel across the bar, thereby affording a harbor of refuge on the inside of Salisbury Beach, and giving easy access at high tide to the wharves at Newburyport for vessels drawing 17 feet, approximately.

This work is located in the collection district of Newburyport, Mass., of which Newburyport is the port of entry. The nearest light-house is on Plum Island, at the entrance of the harbor.

The accompanying commercial statistics for the fiscal year ending June 30, 1889, have been furnished by the collector of customs for Newburyport, Mass.

Money statement.

July 1, 1888, amount available	\$1.73
Amount appropriated by act of August 11, 1888.....	25,000.00
	<hr/> 25,001.73
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$3,946.68
July 1, 1889, outstanding liabilities.....	7,847.11
July 1, 1889, amount covered by existing contracts.....	9,485.55
	<hr/> 21,279.31
July 1, 1889, balance available.....	<hr/> 3,722.39
<hr/>	
{ Amount (estimated) required for completion of existing project	142,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	142,500.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for the delivery of rubble-stone for extension of North Jetty at entrance of Newburyport Harbor, Massachusetts, opened October 31, 1888, by Lieut. Col. G. L. Gillespie, Corps of Engineers.

No.	Names of bidders.	Price bid for rubble-stone per ton of 2,000 pounds.
*1	Rockport Granite Company, by Charles S. Rogers, treasurer, and Pigeon Hill Granite Company, by Frank Scripture, treasurer	\$1.97
2	Edwin Canney	1.90
3	Charles H. Edwards	2.19
4	George Willet Andrews	2.17
5	Thomas A. Rowe	2.37
6	Cape Ann Granite Company, by Jonas H. French, president	2.12

*Lowest bid.

Contract awarded to the Rockport and Pigeon Hill Granite companies, with the approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

Shipping.		Entrances.		Clearances.	
		No.	Tons.	No.	Tons.
Foreign		22	2,762	28	2,778
Domestic		346	94,875	339	93,871

Amount of revenue collected	\$2,470.60	Value of lumber exported	\$1,687.09
Tons of coal imported	4,737	Value of merchandise imported	1,593.09
Value of lumber imported	\$3,502.00	Value of merchandise exported	412.09

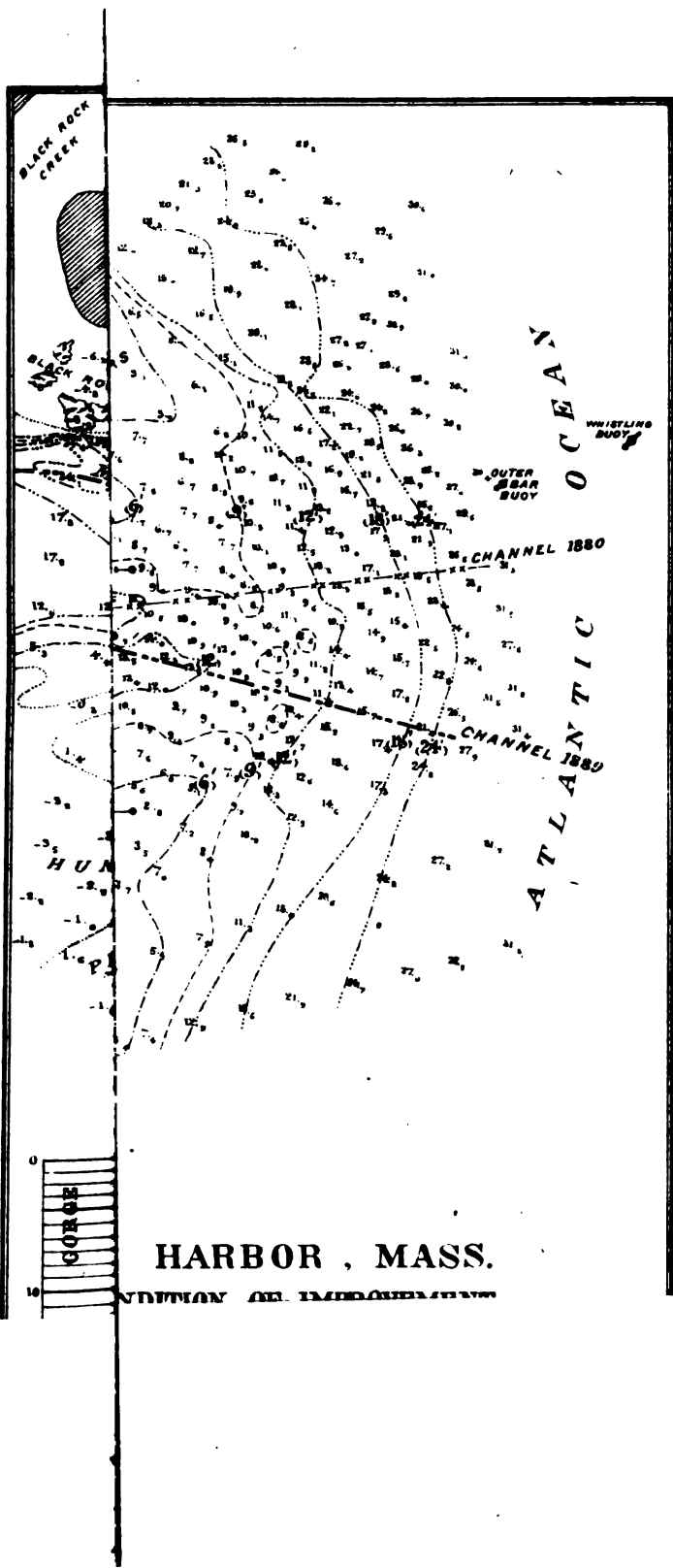
The vessels frequenting the port are steamers and schooners, from 9 to 14 feet draught. In addition to the foreign coal, there has been received by coastwise arrivals about 175,000 tons.

B 2.

IMPROVEMENT OF MERRIMAC RIVER, MASSACHUSETTS.

The mouth of the Merrimac River is 15 miles northwest from Cape Ann, Mass. Tide-water extends up it a distance of 19 miles, or to the foot of the "Upper Falls," $1\frac{1}{2}$ miles above Haverhill, Mass.

Seven incorporated cities and the largest mills in New England are directly interested in its improvement. Before improvement the chan-



HARBOR, MASS.

NOTION OF IMPROVEMENT

nel was narrow and crooked and much obstructed by ledges, boulders, and shoals. At mean low water vessels drawing not to exceed 7 feet could enter the river and proceed to South Amesbury, 9 miles from the mouth. The sea bar at the mouth of the river has been improved under specific appropriations for improvement of Newburyport Harbor, while many sunken rocks and wrecks of piers and vessels lying inside the bar have been removed by general appropriations for the improvement of the river.

The object of the Merrimac River improvement is to straighten, widen, and deepen the natural channel from the bar to the head of tide water at the upper falls of a group known as Mitchell's Falls.

The rise or fall of the tide at the mouth is 7.7 feet; at Haverhill Bridge, bridge, 4 feet.

No plan of the river above Newburyport has been published in the reports of the Chief of Engineers.

The project originally adopted in 1870 proposed to remove obstructions from the Upper and Lower Mitchell's Falls, and to remove the Gangway Rock and the "Boilers" in Newburyport Harbor. The cost was estimated to be \$69,025. This project was modified in 1874 so as to include the removal of rocks in and near the draw of the bridge at Deer Island, 2 miles above Newburyport, and Rock's Bridge and at Little Currier's Shoal, East Haverhill, so that the channel should have the following depths at ordinary high water stages of the river: From the mouth to Deer Island Bridge (5 miles), $16\frac{1}{2}$ feet; from Deer Island Bridge to Haverhill Bridge ($12\frac{1}{2}$ miles), 12 feet; thence to the foot of Mitchell's Falls, Hazeltine Rapids ($1\frac{1}{2}$ miles), 10 feet; through Mitchell's Falls to the head of the Upper Falls ($2\frac{1}{2}$ miles), not less than $4\frac{1}{2}$ feet, when the mill-water at Lawrence is running.

This revised project was estimated to cost \$147,000.

The total appropriations to date have been \$175,500.

The total expenditures to June 30, 1883, were \$170,498.43.

The excess of expenditures over the estimate is due to the removal of rocks and other obstructions that were unknown and removal not contemplated when the estimate was made, and by the expense of necessary surveys and examinations not provided for in the estimate.

The condition of the improvement on June 30, 1888, was as follows: The modified project of 1874 was completed with the exception of the removal of the "Boilers," upon which no work had been done.

During the year ending June 30, 1889, no active operations have been in progress.

The balance available July 1, 1888 (\$1.57), was expended for office expenses.

The project as modified in 1874, has been completed with the exception of the removal of the "Boilers," but from 1883-'86 additional improvements were recommended as follows:

For that part of the river below head of Mitchell's Falls—

1. To remove sunken rocks and shoals from Mitchell's Falls.....	\$1,500
2. To remove the Boilers to a depth of 5 feet at mean low water, 350 cubic yards, at \$25.....	8,750
Contingencies.....	1,250
Total	11,500

To extend the improvement so that the same depth of water as is now obtained through Mitchell's Falls can be carried to Lawrence (a distance of 5 miles from the head of the falls) was in 1882 estimated to cost for dredging through Gages' Shoal and Andover Bar, and removing boulders and ledges, \$11,000.

The improved channel is in good order.

This work is located in the collection district of Newburyport, Mass., of which Newburyport is the nearest port of entry. The nearest light-houses are the Plum Island Lights and the Newburyport Upper Harbor Lights. Commercial statistics are included in statement for Newburyport Harbor.

Money statement.

July 1, 1888, amount available.....	\$1. 57
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	1. 57
<hr/>	
{ Amount (estimated) required for completion of existing project.....	22, 500. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

B 3.

IMPROVEMENT OF POWOW RIVER, MASSACHUSETTS.

Powow River is a tributary of the Merrimac River, which it enters from the north, about $3\frac{1}{2}$ miles above Newburyport. The tide enters the river a distance of about 9,600 feet, following the channel, or to a dam just above the town of Amesbury, Mass. The present channel is narrow, exceedingly crooked, and is not navigable at low water. The mean range of the tide at the mouth of the river is 6.7 feet.

The general project for the improvement of this river was proposed January 24, 1885. It was based on the survey provided for in the river and harbor act of July 5, 1884. This project proposed to make a channel 9,600 feet long, 60 feet wide on the bottom, and 12 feet deep at mean high water, at an estimated cost of \$77,000.

But one appropriation has been made for this improvement, viz, that by the river and harbor act of August 11, 1888, which appropriates \$3,000 for dredging: "*Provided*, That this sum shall not be expended until the towns of Amesbury and Salisbury, or either of them, shall have caused such a draw to be placed in the present bridge over said river as may be approved by the Secretary of War."

On August 25, 1888, the selectmen of the towns of Amesbury and Salisbury were notified of the requirements of the act, and asked what action their respective towns would take in the matter.

On September 5, 1888, the selectmen of Salisbury stated that "no part of the Powow River is now within the limits of the town of Salisbury."

The selectmen of Amesbury submitted the matter at the town-meeting March 23, 1889, and the town referred it to the selectmen and road commissioners as a joint body.

The selectmen instructed the Berlin Iron Bridge Company, of Berlin, Conn., to prepare plans for a new bridge with a draw opening 36 feet in the clear.

On March 28, 1889, the Berlin Iron Bridge Company addressed a letter to the Secretary of War inclosing a plan of the proposed bridge for approval. This plan was approved by the Secretary of War April 10, 1889, and on April 15, 1889, the town authorities were notified of this action.

No action has yet been taken by the joint commission which has the building of the bridge in charge.

To complete the improvement will require an appropriation of \$74,000. Of this amount \$30,000 could be expended to advantage during the fiscal year ending June 30, 1891, if the bridge at the mouth of the river shall have been rebuilt in accordance with the approved plans.

This work is located in the collection district of Newburyport, Mass., of which Newburyport is the nearest port of entry. The nearest light-houses are the Newburyport Upper Harbor Lights.

Commercial statistics are included in statement for Newburyport Harbor.

Money statement.

Amount appropriated by act of August 11, 1888.....	\$3,000.00
July 1, 1889, balance available	3,000.00
<hr/>	
{ Amount (estimated) required for completion of existing project.....	74,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	30,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

B 4.

IMPROVEMENT OF IPSWICH RIVER, MASSACHUSETTS.

Ipswich River empties into Plum Island Sound, 9 miles south of Newburyport, Mass., and at the same distance west of Cape Ann. The head of navigation is 3 miles above the mouth.

The entrance of Plum Island Sound is 2 miles east of the mouth of the river. Six feet depth at mean low water can be carried over the bar at the entrance to the sound, and between the bar and the mouth of the river there is a good anchorage, with from 3 to 5 fathoms of water.

Before improvement the channel of the river from its mouth to "Barras Turn," a distance of 2 miles, was at least 60 feet wide and 4 feet deep at mean low water. From "Barras Turn" to the town wharves, a distance of 1 mile, the channel was narrow and crooked, and had at some places but $1\frac{1}{2}$ feet depth at mean low water. The mean rise or fall of the tide is 8.4 feet.

The original project for improvement was submitted December 6, 1875. It proposed a channel 60 feet wide and 4 feet deep, mean low water, from "Barras Turn" to the town wharves, at an estimated cost of \$25,000.

On November 5, 1883, the original project was divided into three partial projects:

1. The removal of the ledges at Heard's Point, and opposite Nabby's Point, to a depth of 2 feet at mean low water, to open a navigable channel of that depth, at a cost of \$15,900.

2. To dredge the shoals at "Labor in Vain" and "The Shoals," so as to open a channel 4 feet deep at mean low water and 60 feet wide, at a cost of \$2,200.

3. To straighten the channel by making a cut across "Barras Turn," and to build a jetty to close the old channel, at a cost of \$6,900.

In the Annual Report of 1887 it was recommended that the general project be modified by limiting the present improvement to opening a

channel 60 feet wide and 4 feet deep through "The Shoals" and "Labor in Vain," and extending it to the "Deep Hole" opposite the town wharves.

A chart showing this limited project was published in the Report of the Chief of Engineers for 1887.

The amount which has been appropriated for this improvement to date is:

By the act of August 5, 1886.....	\$2,500
By the act of August 11, 1838.....	2,500
Total.....	5,000

The amount expended to June 30, 1888, was \$2,500, and a channel had been dredged 4 feet deep at mean low water, 60 feet wide at "Labor in Vain," and 40 feet wide at "The Shoals."

During the fiscal year ending June 30, 1889, the operations for the improvement of this river were as follows: A project was submitted on August 24, 1888, for the expenditure of the amount made available by the act of August 11, 1888. This project was to dredge about 6,000 yards from "The Shoals" and the cut connecting with the "Deep Hole" opposite the town wharves, thus completing the present partial project. This project was approved by the Chief of Engineers on September 6, 1888.

Sealed proposals for this work were invited by public advertisement according to law, under date of September 24, 1888.

But one bid was received and opened November 1, 1888; it was considered excessive, and was rejected. A copy of the proposal received will be found in the annexed table.

No other operations were in progress during the year ending June 30, 1889, and the improvement remains in the same condition as on June 30, 1888.

It is believed that the funds available are sufficient to complete the present partial project, and that more satisfactory proposals will be offered later in the season when some of the smaller dredging plants are unoccupied. The work will be re-advertised before the close of the working season.

To complete the original project would require an appropriation of \$20,000, but the present proposed partial project, it is believed, will fully meet all the reasonable demands of the present commerce of the river.

Ipswich River is in the collection district of Newburyport, Mass. The nearest light-house is the Ipswich Light, on Castle Neck, about 1½ miles southeast from the mouth of the river.

Commercial statistics are included in Newburyport Harbor.

Money statement.

Amount appropriated by act of August 11, 1888.....	\$2,500.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	32.08
July 1, 1889, balance available.....	2,467.92
<hr/>	
{ Amount (estimated) required for completion of existing project.....	20,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in Ipswich River, Massachusetts, opened November 1, 1888, by Lieut. Col. G. L. Gillespie, Corps of Engineers.

No.	Name of bidder.	Price bid for dredging, per cubic yard, scow inclusive.	Price bid for removal of bowlders, per cubic yard.	Remarks.
1	Thomas Symonds... }	\$1.25 .40	\$15.00	Only bid received, dredging above Heard's Point. Dredging below Heard's Point. Bowlders weighing over 2 tons.

Bid was rejected, with the approval of the Chief of Engineers.

B 5.

HARBOR OF REFUGE, SANDY BAY, CAPE ANN, MASSACHUSETTS.

Sandy Bay is situated at the northeastern extremity of the promontory of Cape Ann, which forms the northern limit of Massachusetts Bay. The shore lines of the bay form a little less than a right angle, and their directions are nearly north and south and east and west. The rocky island of Straitsmouth forms the eastern extremity of one shore line, and the steep headland of Andrew's Point the northern end of the other. Following the line of the proposed breakwater, the bay is 2½ miles wider, and it has a depth of 2 miles, approximately.

The bay on the land side is perfectly protected by steep, high hills, but it fronts the northeast, and is open to the full force of the violent northerly and easterly gales of this coast.

The great seas of the ocean are broken, however, in a degree by the sunken rocky ledges called Avery's Ledge, the Dry and Little Salvages, the Flat Ground, and Abner's Ledge, which are directly at the mouth of the bay. Inside these entrance ledges the bay is entirely unobstructed, and has an average depth of 50 feet at mean low water.

A plan of the bay showing the proposed breakwater was published in the Annual Report of the Chief of Engineers for 1886, page 582.

The project for improvement was submitted in 1884. It proposes a continuous breakwater 9,000 feet long, divided into two branches: One starts at Avery's Ledge and runs in a direction a little west of north to Abner's Ledge, a distance of 3,600 feet; the other extends 5,420 feet from Abner's Ledge in a northwesterly direction, and terminates at the 83-foot contour off Andrew's Point.

The axis of the proposed breakwater is approximately at the inner edge of the ledges at the entrance of the bay, and about 1 mile inside the Salvages and Flat Ground, which receive the first shock of easterly storm waves.

The southern entrance to the proposed harbor lies between Straitsmouth Island and Avery's Ledge, and is to be 1,800 feet wide and at least 30 feet deep. The northern entrance, near Andrew's Point, is 2,700 feet wide and 80 feet deep. They are so located with reference to each other that vessels can enter and leave the harbor with any wind.

The harbor formed by the breakwater covers an anchorage of 1,377 acres, in which the depth exceeds 24 feet at mean low tide.

The breakwater will be formed to the level of 22 feet below low water, of a mound of broken stone, 40 feet wide at top, above which a masonry

wall has been suggested, whose crest shall be 15 feet wide and 8 feet above extreme high water. The detailed plan for the construction of the masonry wall has not been definitely adopted, and operations have been confined to the construction of the rubble-stone mound, or substructure of the breakwater. This is effected by dropping stone from vessels and self-dumping scows along the axis of the breakwater, extending to the eastward and westward, a distance of 20 feet approximately. The axis is indicated by an iron spindle on Avery's Ledge, when in range with the south light-house on Thatcher's Island; cross-ranges are established by iron pipes let into the rocks on the Dry and Little Salvages, which mark points at intervals of 100 feet from the spindle (initial point) on Avery's Ledge. The estimated cost of the improvement is \$5,000,000, to which must be added \$2,500,000 for buoyage, lighting, and defense of the harbor.

These estimates are based upon consecutive annual appropriations of not less than 10 per cent. of the original estimates of cost.

Should operations be suspended at any time from want of funds, or annual appropriations be reduced to small sums for a series of years, the expenses for the final construction will be proportionally increased.

The amount which has been appropriated to date is \$300,000.

The total amount expended to June 30, 1888, inclusive of outstanding liabilities, was \$194,125.24.

On June 30, 1888, 242,934 tons of rubble-stone had been deposited between cross-ranges 140 and 2340, thus essentially completing 2,200 running feet of the substructure of the breakwater. From the nature of the work, the top of the mound was somewhat irregular, and the depth of water over it at low tide varied from 18 to 23 feet.

During the fiscal year ending June 30, 1889, a survey of the rubble-mound was made. On August 24, 1888, a project was submitted for the expenditure of the amount (\$100,000) appropriated for this work by the river and harbor act of August 11, 1888.

This project proposed to continue the deposit of stone in the substructure of the breakwater; it was approved by the Chief of Engineers September 6, 1888.

Sealed proposals were invited by public advertisement according to law for the execution of this work, and on October 31, 1888, the two bids received were opened, and the lowest accepted by authority of the Chief of Engineers, dated November 3, 1888.

On November 20, 1888, a contract was entered into with the lowest bidders, the Rockport and Pigeon Hill Granite Companies, for the delivery in place of 110,000 tons, more or less, of rubble-stone, at 71 cents per ton of 2,000 pounds.

During the latter part of November, 1888, the spindle marking the initial point of the breakwater was broken off. It was recovered, re-forged and re-erected on January 1, 1889.

Operations under the contract of November 20, 1888, were commenced on January 2, 1889, and during the year ending June 30, 1889, 41,965 tons of rubble-stone were deposited in the breakwater, between cross-ranges 2340 and 2940.

The total amount of stone deposited in the breakwater to June 30, 1889, is 284,899 tons.

To complete the project will cost \$4,700,000, approximately.

During the fiscal year ending June 30, 1891, \$250,000 could be expended to advantage in the extension of the substructure of the breakwater in the direction of Abner's Ledge.

The prospective benefits to commerce and navigation by the construc-

tion of this harbor of refuge are, increased safety to life and property, and a consequent reduction in freight and insurance.

Sandy Bay is situated in the collection district of Gloucester, Mass.

The nearest light-house is Straitemouth Light, situated on Straitemouth Island, at the southern entrance of the bay.

The accompanying commercial statistics for the fiscal year ending June 30, 1889, have been furnished by the collector of customs at Gloucester, Mass.

Money statement.

July 1, 1888, amount available.....	\$5,874.76
Amount appropriated by act of August 11, 1888.....	100,000.00
	<hr/> 105,874.76
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$28,740.02
July 1, 1889, outstanding liabilities.....	8,896.52
July 1, 1889, amount covered by existing contracts.....	48,304.25
	<hr/> 85,941.39
July 1, 1889, balance available.....	<hr/> 19,933.37
<hr/>	
{ Amount (estimated) required for completion of existing project.....	4,700,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891.....	250,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for the delivery of rubble-stone for harbor of refuge, Sandy Bay, Cape Ann, Massachusetts, opened October 31, 1888, by Lieut. Col. G. L. Gillespie, Corps of Engineers.

No.	Names of bidders.	Price bid for rubble-stone per ton of 2,000 pounds.
		<i>Cents.</i>
*1	Rockport Granite Company, by Charles S. Rogers, treasurer, and Pigeon Hill Granite Company, by Frank Scripture, treasurer.....	71
2	Charles H. Edwards.....	76½

*Lowest bid.

Contract awarded to the Rockport and Pigeon Hill Granite Companies, with the approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

CUSTOM-HOUSE, COLLECTOR'S OFFICE,
Gloucester, Mass., July 1, 1889.

SIR: In reply to your letter of the 10th ultimo, I have the honor to say that there was no foreign commerce at Rockport, Mass., during the year ending June 30, 1889.

I have no data regarding the domestic commerce, as the inspectorship at that place was abolished January 1, 1888.

Respectfully, yours,

D. S. PRESSON,
Collector.

Col. S. M. MANSFIELD,
Lieut. Col. of Engineers.

B 6.

IMPROVEMENT OF HARBOR AT GLOUCESTER, MASSACHUSETTS.

This is the most important harbor between Boston and Portland, and is the principal resort for all New England fishing vessels. It is situated at the southeastern extremity of Cape Ann, 20 miles northeast from Boston. It is easily entered when the dangerous storms of this coast occur, and provides a secure ample shelter for all classes of vessels except from south winds, and from these a moderate extent of protected anchorage is afforded in the inner harbor.

It contains in the outer roadstead, the inner harbor, and in the channel connecting them, sufficient deep water for the most liberal demands of commerce; but the inner harbor and channel are obstructed by bowlders, ledges, and shoals, dangerous and inconvenient to shipping, and the outer harbor or roadstead is open to the action of all southerly winds.

A plan of the harbor was published in the Annual Report of the Chief of Engineers for 1887, page 506.

The first project formed for improvement was submitted January 20, 1871, and was based on the survey ordered by the act of July 11, 1870. (Report of the Chief of Engineers, 1871, page 869.)

This project proposed the removal of certain bowlders from the inner harbor at a cost of \$10,606.20, and the construction of a breakwater from Eastern Point over Dog Bar to Round Rock Shoal, at an estimated cost of \$494,148.65.

On November 19, 1884, Major Raymond, Corps of Engineers, by order of the special Board of Engineers that was considering the subject of the Sandy Bay breakwater, submitted a project for two breakwaters at the entrance of Gloucester Harbor, one to cost \$752,000, on essentially the same site as that proposed in 1871; and a supplementary one through Norman's Woe Rock, to cost \$607,000. This project and estimate are published in the Chief of Engineer's Report for 1885, page 534.

On January 20, 1885, it was recommended, in accordance with act of July 5, 1884, that a survey of the inner harbor and of the reef off Muscle Point be made, and that Babson's Ledge be removed to 21 feet at mean low water. (Report Chief of Engineers, 1885, page 541.)

In the annual report for this harbor for 1887, a general project for its improvement was submitted, based on the survey provided for by act of Congress approved August 5, 1886. (Chief of Engineers' Report, 1887, page 500.)

This project proposed to remove from the inner harbor $101\frac{1}{2}$ cubic yards of rock known to exist, and to dredge 216,000 cubic yards, scow measurement, at an estimated cost of \$65,000; and to construct the breakwater recommended in the project of 1884, that extends from Eastern Point to Round Rock Shoal, at an estimated cost of \$752,000.

The total appropriations for this harbor to date have been \$25,000.

The amount expended to June 30, 1888, was \$15,000.

The condition of the improvement on June 30, 1888, was as follows: Clam Rock had been reduced from 1 foot to $9\frac{1}{2}$ feet at mean low water; Pinnacle Rock from $8\frac{1}{2}$ to $16\frac{1}{2}$ feet, mean low water; rock off Pew's Wharf from 2 to 5 feet, mean low water; rocks off J. Friend's Wharf, from 13 to 17 feet, mean low water. All of the above rocks were reduced to the level of the surrounding bottom.

Babson's Ledge had been reduced from 11 to 14 feet, mean low water. No work had been done on the breakwater.

The river and harbor act of August 11, 1888, appropriated \$10,000 for "dredging Harbor Cove and removing ledge and bowlders obstructing the approach to the wharves between Harbor Cove and Pew's Wharf."

On August 24, 1888, a project was submitted for the expenditure of the funds thus specifically appropriated. It was approved September 7, 1888.

This project proposed to expend \$7,000 for dredging and \$3,000 for the removal of ledges.

The dredging was to be done from two channels, one on the east side of Harbor Cove, 550 feet long, the other on the west side, 1,000 feet long; both were to be 40 feet wide and 10 feet deep at mean low water. The ledges to be removed were numbered on the plan of the harbor above referred to, 1, 3, 5, 6, 7, 8, 9, and 10, and were estimated to contain 101 cubic yards approximately. Ledge No. 1 was to be reduced to 12 feet at mean low water, or the depth of the surrounding bottom; the others to 15 feet, mean low water, the depth of the improved channel as proposed by the general project.

Specifications and advertisements were prepared and issued, and the bids were opened October 31, 1888. A copy of the proposals received will be found in the annexed table.

On November 24, 1888, a contract was entered into with Mr. G. W. Townsend for the removal of 70 cubic yards of loose rock at \$15 per yard, and 100 cubic yards of ledge at \$20 per yard. This contract was to expire December 31, 1889.

Operations under it were commenced in March, 1889, and it was satisfactorily completed June 19, 1889.

On November 27, 1888, a contract was entered into with the Bay State Dredging Company to remove from Harbor Cove 18,000 cubic yards of material at 30 cents per yard, scow measurement. This contract was to expire December 31, 1889.

Operations under it were commenced in February, 1889, and satisfactorily completed in March, 1889, by the removal of 17,596 cubic yards.

No other operations were in progress during the year ending June 30, 1889, and at that date all of the ledges and shoals which appeared to require blasting had been removed from that part of the harbor covered by the present general project for its improvement; and two channels had been dredged in Harbor Cove, approximately parallel to the heads of the wharves; the east channel was 550 feet long, the west 1,000 feet long, both were 40 feet wide, and 10 feet deep at mean low water, except over a small ledge uncovered by the dredging in the east channel off Parmenter's Wharf. To complete the improvement would require an appropriation of \$55,000 for dredging, and \$752,000 for the breakwater at Eastern Point. Of this amount \$305,000 could be expended to advantage during the fiscal year ending June 30, 1891, in completing the proposed dredging and in commencing the breakwater.

The prospective advantages to commerce by the completion of the improvement are greater facilities and safety in the movement of vessels in the harbor, and a more secure anchorage for vessels seeking protection from southerly gales.

Gloucester Harbor is in the collection district of Gloucester, Mass., of which Gloucester is the port of entry.

The nearest light-houses are Ten Pound Island Light, in the harbor, and Eastern Point Light, at its entrance.

The accompanying commercial statistics for the fiscal year ending June 30, 1889, have been furnished by the collector of customs at Gloucester, Mass.

Money statement.

Amount appropriated by act of August 11, 1888.....	\$10,000.00
July 1, 1889, amount expended during fiscal year, exclusive of	
liabilities outstanding July 1, 1888.....	\$9,326.46
July 1, 1889, outstanding liabilities.....	240.00
	<hr/> 9,566.46

July 1, 1889, balance available 433.54

{ Amount (estimated) required for completion of existing project.....	807,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	305,000.00
{ Submitted in compliance with requirements of sections 2 of river and	
harbor acts of 1866 and 1867.	

Abstract of proposals for dredging and blasting in Gloucester Harbor, Mass., opened October 31, 1888, by Lieut. Col. G. L. Gillespie, Corps of Engineers.

Number.	Names of bidders.	Price bid per cubic yard.		
		For dredging as measured in c.w.s.	For removal of rock measured in situ.	For removal of loose material overlying the ledge measured by water displacement.
1	Thomas Symonds	<i>Cents.</i> 40	\$35.00	
*2	George W. Townsend.....		20.00	\$15.00
3	Horace M. Sargent and John F. Hamilton.....		32.00	1.50
†4	Bay State Dredging Company, A. B. Martin, proprietor	30		
5	Hiram W. Phillips.....		28.00	6.00
6	New England Dredging Company, by Charles H. Souther, president.....	37		

* Lowest bid for rock removal, loose material, boulders, etc., not exceeding 70 cubic yards.

† Lowest bid for dredging.

Contract awarded to G. W. Townsend, for removal of rock to Bay State Dredging Company for dredging, with the approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

Shipping.	Foreign.			Domestic.	
	Number.	Tonnage.	Value.	Number.	Tonnage.
Entrances	129	23,900	\$115,851	8	918
Clearances	150	18,761	11,910		

Amount of revenue collected	\$15,627.08	Merchandise imported.....	tons.. 2,409
Lumber imported.....	tons.. 200	Salt imported.....	do..18,123

All classes of vessels frequent the port; 4,675 were "boarded;" their draught varied from 9 to 23 feet.

B 7.

IMPROVEMENT OF HARBOR AT MANCHESTER, MASSACHUSETTS.

Manchester Harbor is situated about $5\frac{1}{2}$ miles, northeastward from the entrance of Salem Harbor, Massachusetts.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for 1888, part I, page 466.

The outer sheltered roadstead contains approximately 300 acres, with 5 fathoms of water.

The entrance channel from the roadstead to Proctor's Point is everywhere at least 100 feet wide, at least $6\frac{1}{2}$ feet deep at mean low water, and is unobstructed. At the "Narrows," distant 1,400 feet inside of Proctor's Point, the depth in the channel is reduced to $1\frac{1}{2}$ feet at mean low water; thence to the town wharves, a further distance of 2,500 feet, no low water channel exists. Near the town wharves the channel is crossed by the Boston and Maine Railroad (eastern division) on a bridge which is provided with a draw opening 28 feet wide.

The original project for the improvement of this harbor was submitted November 28, 1887. It was based on a survey provided for in the river and harbor act of August 5, 1886. It proposed to dredge a channel 60 feet wide, 4,000 feet long, and 4 feet deep at mean low water, from Proctor's Point to the town wharves, at an estimated cost of \$14,300.

But one appropriation has been made for this improvement, that by the act of August 11, 1888, \$2,500.

On August 24, 1888, a project for the expenditure of this appropriation was submitted. It proposed to remove 150 cubic yards of ledge from the proposed channel between Proctor's Point and the Bow Bell ledge. This project was approved September 17, 1888.

Specifications and advertisement were prepared and issued and bids opened November 2, 1888. A copy of the proposal received will be found in the annexed table.

On November 22, 1888, it was recommended that no contract be executed for the proposed rock removal, but that the money appropriated for this improvement be retained in the treasury until further funds are available. This recommendation was approved by the Chief of Engineers November 26, 1888.

No other operations have been in progress during the year ending June 30, 1889, and the harbor remains in its original condition.

To complete the improvement will require an appropriation of \$11,800, all of which could be expended to advantage during the fiscal year ending June 30, 1891.

Manchester Harbor is in the collection district of Gloucester, Mass., of which Gloucester is the port of entry. The nearest light-house is situated upon Baker's Island, $2\frac{1}{2}$ miles from Proctor's Point.

The existing commerce is nominal and the commercial statistics are included in Gloucester Harbor.

Money statement.

Amount appropriated by act of August 11, 1888.....	\$2,500.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	103.07
July 1, 1889, balance available.....	<u>2,396.93</u>

{	Amount (estimated) required for completion of existing project.....	\$11,800.00
	Amount that can be profitably expended in fiscal year ending June 30, 1891	11,888.00
	Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for the removal of ledge from the harbor of Manchester, Mass.; opened November 2, 1888, by Lieut. Col. G. L. Gillespie, Corps of Engineers.

Number.	Names of bidders.	Price bid for removal of—	
		Rock per cubic yard measured in situ.	Loose material overlying ledge per cubic yard.
1	George W. Townsend	\$28.00	\$18.00
2	Thomas A. Rowe	28.75	2.75

* Lowest bid.

Contract not awarded, with the approval of the Chief of Engineers.

B 8.

IMPROVEMENT OF HARBOR AT LYNN, MASSACHUSETTS.

Lynn Harbor is situated 9 miles northeast from Boston. It is 1 by 2 miles approximately in extent, the greater part of which is dry at low water.

It is protected on the north and west by the mainland and on the east by Nahant Beach, and its entrance, 2 miles wide, into Massachusetts Bay is on the south side.

A plan of the harbor showing the projected improvement was published in the Annual Report of the Chief of Engineers for 1884, part I, page 532.

Before improvement three narrow and crooked channels of approach to the wharves existed, in each of which there was about 6 feet depth at mean low water. The mean rise or fall of the tide is $9\frac{1}{2}$ feet.

The western channel leads to the Point of Pines and the mouth of Saugus River. The main ship-channel is entered between White and Lobster rocks, and connects about 3,600 feet northward with the Black Rock channel, which is the most eastern near Nahant Beach.

The project for improvement was adopted in 1884. It provides for the excavation of a channel 200 feet wide and 10 feet deep at mean low water, from a point near and east of the White Rocks to deep water opposite Little Nahant, a distance of 3,610 feet; this is called the outer improved channel and is merely a rectification and deepening of the main ship-channel. The combined main ship and Black Rock channels are sufficient for the purposes of commerce for the next 2,500 feet. Then commences the inner improved channel which is projected 6,450 feet long, 200 feet wide, and 10 feet deep at mean low water. It extends from deep water opposite Sand Point to the harbor commissioners' line, and follows very closely in direction the extension of the united main ship and Black Rock channels.

On September 24, 1888, this project was modified. It was then proposed to extend the main ship-channel 400 feet within the harbor line

and to excavate at its inner end a basin 500 by 300 feet in area, 10 feet deep at mean low water.

It is supposed that the inner channel will need to be dredged occasionally to maintain its width and depth; but a training-wall, about 6,000 feet long, has been proposed, to aid in keeping the outer channel open, if experience shall show it to be necessary.

This wall is to start from the shore at "Little Nahant," and is to cross the Black Rock Channel. Its outer portion is to be parallel to the outer improved channel. The cost of the original project was estimated to be \$145,000. This estimate was revised in 1885, and then made \$157,000, to provide for an increased amount of dredging found to be necessary during the progress of the work, to round off the junctions of the natural channel with the dredged channel, to provide flatter slopes to the sides of the cuts than was originally designed, and also to provide funds for necessary surveys during the progress of the work.

The modifications proposed September 24, 1888, were estimated to cost \$25,000, which would make the total cost of the improvement \$182,000.

The total appropriations for this harbor to date have been \$76,000.

The amount expended to June 30, 1888, was \$65,962.60.

On June 30, 1888, the outer channel had been completed, as proposed, 3,610 feet long, 200 feet wide, 10 feet deep, at mean low water. The inner channel was 6,450 feet long, 10 feet deep at mean low water, and 150 feet wide, or 50 feet less than proposed.

On September 24, 1888, a project was submitted for the expenditure of \$10,000, made available for this improvement by the river and harbor act of August 11, 1888. This project was to deepen two shoal spots in the western channel after a survey had shown their exact character, to excavate part of the interior basin north of the harbor line, and to connect this basin with the main ship-channel.

This project was approved September 26, 1888. Specifications and advertisement were prepared and issued September 24, 1888, for the proposed dredging, and the bids received were opened November 3, 1888. A copy of the proposals will be found in the annexed table.

On November 23, 1888, a contract was entered into with the Bay State Dredging Company to dredge 28,000 cubic yards, part of which may be from the western channel. The price to be paid for dredging from the main ship-channel and basin is 29 cents, and from the western channel 45 cents per cubic yard, scow measurement.

No operations have been in progress under this contract during the fiscal year ending June 30, 1889. It expires December 31, 1889.

During the latter part of June, 1889, a survey of the mouth of Saugus River was commenced, in order that its exact condition may be known, to determine what part, if any, of the available funds for this harbor will be spent for the improvement of this western channel.

No other operations were in progress during the fiscal year and the condition of the improvement is the same as on June 30, 1888.

To complete the improvement will require an appropriation of \$106,000, of this amount \$50,000 could be expended to advantage during the fiscal year ending June 30, 1891.

Lynn is a port of entry in the collection district of Marblehead, Mass.
The nearest light-house is Egg Rock (Nahant) Light, 3 miles distant.

The accompanying commercial statistics for the fiscal year ending June 30, 1889, have been furnished by the collector of customs at Marblehead, Mass.:

Money statement.

July 1, 1888, amount available	\$37. 40
Amount appropriated by act of August 11, 1888.....	10,000. 00
	<u>10,037. 40</u>
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$53. 32
July 1, 1889, outstanding liabilities.....	228. 50
July 1, 1889, amount covered by existing contracts.....	8,120. 00
	<u>8,401. 82</u>
July 1, 1889, balance available.....	1,635. 58
<hr/>	
{ Amount (estimated) required for completion of existing project	106,000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	50,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in Lynn Harbor, Mass., opened November 3, 1888, by Maj. John P. Hawkins, C. S. U. S. A., during the official absence of Lieut. Col. G. L. Gillespie, Corps of Engineers.

Number of proposal.	Names of bidders.	Price bid for.			Time of commencement.
		Dredging per cubic yard, scow measurement.		Removal of bowlders over 3 tons each per cubic yard.	
		In main ship-channel.	In Saugus River channel.		
		<i>Cents.</i>	<i>Cents.</i>		
1	Edward Moore and Augustus R. Wright.....	31	.....	\$10.00	Omitted.
2	New England Dredging Company by Charles H. Souther, president.....	32	45	10.00	Do.
3	National Dredging Company, by George G. Barker, vice-president.....	30	.....	.....	Do.
*4	Bay State Dredging Company, by A. B. Martin, proprietor.....	29	45	10.00	June 1, 1889.

* Lowest bid.

Contract awarded to Bay State Dredging Company, with the approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

Shipping.	Foreign.			Domestic.		
	Number.	Tonnage.	Value.	Number.	Tonnage.	Value.
Entrances	45	4,946	\$24,445	476	118,750	\$853,400
Clearances.....	51	5,680	300	472	110,500	.....

Amount of revenue collected	\$6,496. 05
Coal imported	tons 145,000
Lumber imported	feet 3,220,000
Value of miscellaneous articles imported	\$126,000
Value of miscellaneous articles exported	300

All classes of vessels frequent the port; their draught not exceeding 14 feet. Of the coal imported, 2,100 tons were foreign; of the lumber imported, 2,500,000 feet were foreign.

B 9.

IMPROVEMENT OF HARBOR AT WINTHROP, MASSACHUSETTS.

This harbor is situated in the northeastern part of Boston Harbor, immediately westward of Winthrop Head.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for the year 1888, Part I, page 470.

The harbor contains, approximately, 350 acres, all of which is dry at low tide except a short, narrow, crooked slough east of Snake Island. To the town wharf no low-water channel exists. The mean range of tides is 9.4 feet.

The nearest deep-water channel of Boston Harbor is known as the "Back" Channel, and it extends from Point Shirley to East Boston. It has from 9 to 16 feet depth at low tide. The town wharf is distant from this "Back" Channel 3,900 feet.

The original project for the improvement of this harbor was submitted November 28, 1887; it was based on the survey provided for in the river and harbor act of August 5, 1886.

The project proposes to excavate a straight channel 3,900 feet long, 50 feet wide, and 6 feet deep at mean low water, from the "Back" Channel to "Rice's" Wharf, at an estimated cost of \$17,600.

But one appropriation has been made for this improvement, viz, \$1,000 by the river and harbor act of August 11, 1888.

On August 24, 1888, it was recommended that the amount available for this improvement be retained in the Treasury until additional funds are provided. This recommendation was approved by the Chief of Engineers September 17, 1888.

No other operations have been in progress during the year ending June 30, 1889, and the original condition of the harbor is unchanged.

The beaches and headlands protecting this harbor on the east were seriously abraded by the storms of the last winter, and if this continues they will require protection, not only to secure this minor harbor, but to prevent injury to the main harbor of Boston. To complete the improvement will require an appropriation of \$16,600, all of which could be expended during the fiscal year ending June 30, 1891.

Winthrop Harbor, Massachusetts, is in the collection district of Boston, Mass., of which Boston is the port of entry; the nearest light-house is situated upon Long Island Head, Boston Harbor, Massachusetts.

The existing commerce is nominal, and commercial statistics are included in Boston Harbor, Massachusetts.

Money statement.

Amount appropriated by act of August 11, 1888.....	\$1,000.00
July 1, 1889, balance available.....	1,000.00
<hr/>	
{ Amount (estimated) required for completion of existing project.....	16,600.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	16,600.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

B 10.

IMPROVEMENT OF HARBOR AT BOSTON, MASSACHUSETTS.

Boston Harbor consists essentially of an inner and an outer harbor, united by a deep water-way, and each accessible from the sea by a distinct channel, widening into a deep and spacious roadstead.

1. *Inner harbor.*—This harbor lies to the north and westward of Long Island, and has deep water and a good anchorage in the President Roads, seaward of Lower Middle Bar, and also near the city westward of Upper Middle Bar.

Four rivers discharge their waters into this basin: the Charles, Mystic, and Chelsea rivers from the north, and the Neponset from the south. The direct entrance from the sea is by Broad Sound.

2. *Outer harbor.*—This harbor lies to the southward of Long Island, and has a fine anchorage in Nantasket Roads, as well as in Hingham Bay, a well sheltered harbor southeast of Paddock Island. It connects with the inner harbor by the main ship-channel through the "Narrows," and by secondary channels east and west of Long Island.

It is reached from the sea by Nantasket Roads, which lie south of George's and Great Brewster islands, and is marked at the sea entrance by Boston Light.

Both the inner and outer harbors are subdivided into several minor harbors, and contain many islands, which shelter the anchorage from winds and storm waves.

The range of the tides at the navy-yard is 9.8 feet, and at the entrance to the outer harbor 9.4 feet.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for 1888, Part I, page 454.

The object of the improvement is, first, to *preserve* the harbor by protecting the islands and headland, and, second, to *improve* it by widening, deepening, and straightening the channels.

The projects adopted for this purpose since 1866 have been mainly in accordance with the recommendations of the United States commissioners, whose labors terminated during that year.

The works of *preservation* consist of sea-walls, aprons, jetties, etc., which protect the shores of the islands and headlands, prevent additional wash into the channels, control the tidal scour, and preserve the full height of anchorage shelter for vessels in the roadsteads.

The works of improvement have been by dredging and blasting.

The amount which has been appropriated for this harbor to date is \$1,788,750.

The total expenditures to June 30, 1888, were \$1,654,020.74 (inclusive of outstanding liabilities).

WORKS OF PRESERVATION.

Point Allerton.—This headland, at the southeasterly entrance of the harbor, is protected by a granite sea-wall 1,202 feet in length, completed in 1873. Its concrete foundation for a distance of 1,005 feet, is protected by an apron and eight short jetties of granite rubble stone.

No work was done on it during the fiscal year. Its condition June 30, 1889, is as follows: The wall is generally in good order, although some of its joints should be repointed. The bluff protected by this wall is not fully covered from storm action, and the sea-wall should be extended westward for a distance of at least 150 feet, and the foundation of the extension should be protected with riprap.

This is estimated to cost \$15,000.

Great Brewster Island.—This island is on the north side of the main ship-channel, near the entrance. It is protected by a granite sea-wall 2,840 feet long, which was completed in 1869. No work was done on it during the fiscal year, and on June 30, 1889, it was in fair order. Many of the joints require repointing, and some of the coping course should be reset. These necessary repairs are estimated to cost \$10,000.

George's Island.—Its northern and eastern shores are protected by a granite sea-wall 2,150 feet long. West of this wall a riprap improvement extends for 450 feet, and south of it another 600 feet long. The sea-wall and southern riprap were built about 1835. The western riprap was built in 1884-'85. The coping course was repaired during the year ending June 30, 1889, by hired labor at a cost of \$300, and the wall and ripraps are in good order at the date of this report. The unprotected western shore-line of the island, in front of the Government buildings, was considerably abraded; the high-water line had been moved back in places nearly 25 feet. This shore-line should be protected by a light sea-wall, 1,400 feet long, at a cost of \$35,000.

Lovell's Island.—The western shore of this island is protected by a rubble-stone apron 975 feet long, built in 1873, and repaired and extended in 1884; the northern shore is covered by a granite sea-wall 750 feet long, built in 1843, and the eastern shore is protected by a granite sea-wall 800 feet long, built in 1869 and repaired in 1879 and 1886, and by two rubble-stone aprons, one between the northern and eastern sea-walls, 1,440 feet long, and the other south of the east sea-wall, 1,330 feet long. No operations were in progress during the fiscal year. The condition of the work on June 30, 1889, was as follows: The sea-walls and the ripraps on the eastern shore were in good order; the western shore riprap had been undermined in places and had fallen down, but it needed no immediate repairs.

Gallop's Island.—The western, northern, and eastern shores of this island are protected by a granite sea-wall 1,785½ feet long, completed in 1871, and by a rubble stone apron completed in 1884, 3,050 feet long, which also covers the foundation of the sea-wall.

On August 24, 1888, it was recommended that "\$15,000" be expended "from the funds appropriated by the act of August 11, 1888, for the improvement of Boston Harbor, in extending the sea-wall which protects Gallop's Island." This recommendation was approved September 6, 1888.

Specifications and advertisement for the stone required for this extension were prepared and issued; bids received were opened November 3, 1888. A copy of the proposals will be found in the annexed table.

On November 23, 1888, a contract was entered into with the Pigeon Hill Granite Company for the delivery of 1,500 running feet of granite ashlar, and 300 square yards of shell-stone paving. This contract was satisfactorily completed in June, 1889.

On September 27, 1888, the city of Boston conveyed to the United States the site of the proposed sea-wall extension, and this conveyance was accepted by the Secretary of War.

The construction of the sea-wall extension by hired labor was commenced in May, 1889, and at the close of the fiscal year about one-fourth of the work had been completed.

On June 30, 1889, the condition of this improvement was as follows: The walls and ripraps were in good order, but the shore from the end of the present proposed extension of the wall to the west wharf had

been seriously abraded and needed the protection of a light sea-wall, which is estimated to cost \$12,000.

Deer Island.—Three prominent bluffs of this island are protected by granite sea-walls originally built about 1827. The north head wall is 1,740 feet long; the middle head wall is 840 feet, and the south head wall is 380 feet long. In 1865 and 1869 these walls were partly rebuilt, and in the weakest places were backed with concrete. They were all originally built dry, and from time to time have required repairs. During the winter, 1888-'89, the north and middle head walls were seriously injured by storms. One hundred feet, approximately, of wall will require rebuilding, and 150 feet of the coping course and shell-stone paving needs resetting. These repairs will be made early in the next fiscal year. The remainder of the works of preservation are in good order • June 30, 1889.

Long Island.—The north head of this island is protected by a granite sea-wall 2,081½ feet long, completed in 1874. Part of the foundation of the sea-wall and of the beach at both of its ends are protected by a rubble-stone apron, aggregating 1,375 feet in length. This apron was built in 1874 and extended in 1884. No operations were in progress during the fiscal year. On June 30, 1889, the wall needed to be re-pointed in places, the riprap was in fair order and should be extended about 250 feet to more fully protect the southeastern shore; these repairs and extensions are estimated to cost \$3,000.

Rainsford Island.—The north head of this island is protected by a dry granite sea-wall 1,500 feet long, originally built about 1840 and extensively repaired in 1884-'85. No work was done during the year, and on June 30, 1889, the wall was in good order and needed no repairs.

Castle Island.—The north and part of the east and west shores of this island are protected by a dry granite sea-wall 3,300 feet long, built in 1835. A light riprap extends along the east shore 300 feet from the end of the wall; this was built in 1865. No work was done during the fiscal year, and on June 30, 1889, the riprap was in good order. The sea-wall needed repairs on the north face a short distance west of the wharf, where the foundation has been undermined and the wall has settled. About 100 running feet of the wall has been thus injured, and this length of the wall needs taking down and rebuilding, at a cost of \$1,000.

Governor's Island.—The shore line of this island has never been protected. The east and south bluffs, however, should be covered by sea-walls to prevent any additional abrasion, not only to secure the sites of the important heavy batteries which occupy these bluffs, but also to prevent injury to the main ship-channel. The east bluff wall should be 500 feet long, and is estimated to cost \$30,000; the south bluff wall should be 1,800 feet long, and will cost \$50,000.

WORKS OF IMPROVEMENT.

The main ship-channel.—Before improvement it had a least width of 100 feet and a least depth of 18 feet at mean low water. The general project for its improvement was submitted in 1867. It proposed to dredge the channel 23 feet deep at mean low water, 1,000 feet wide at the "Upper" and "Lower" Middles, and 685 feet wide at the "Narrows." In 1870 the proposed width at the Narrows was reduced to 625 feet, and at Anchorage Shoal, in the inner harbor, increased to 1,100 feet. In 1887 it was proposed to straighten the passage through the "Narrows" by cutting off a spur that projected from Lovell's Island, which was estimated to contain 20,000 cubic yards.

On June 30, 1888, the condition of the main ship-channel was as follows: It was 23 feet deep at mean low water, 1,100 feet wide west of the "Upper Middle," 600 feet wide at the Upper Middle, 1,000 feet wide at the "Lower Middle," and 625 feet wide at the "Narrows."

In effecting this improvement dredging and blasting were done at the following places:

At *Nash's Rock Shoal*, during the years 1876–1878, 365 cubic yards of ledge were removed.

At *Kelly's Rock and Shoal*, during the years 1869–1879, 222 cubic yards of ledge were removed.

Tower, Corwin, and Channel Rocks were removed during the years 1867–1875. They aggregated 608½ cubic yards.

From the west end of *Brewster's Spit*, during the years 1874–1876, 29,226 cubic yards of sand and gravel were dredged and 95½ cubic yards of ledge were removed.

At *Lovell's Island*, from the southeast and southwest points, 267,294½ cubic yards were dredged during the years 1867–1877; and from a spur between these points 3,430 cubic yards were dredged in 1888.

At *Castle Island Bar and Shoal*, opposite the Lower Middle, during the years 1880–1883, 36,957 cubic yards were dredged and 20 tons of rock were removed.

At the *Lower Middle*, in 1874–1875, State and Palmyra rocks were removed; they aggregated 62 cubic yards. In 1887–1888, 65,576 cubic yards were dredged from this shoal.

At the *Upper Middle*, during the years 1870–1876, 268,278½ cubic yards were dredged and 118½ cubic yards of ledge were removed.

At *Anchorage Shoal*, during the years 1879–1882, 65,327 cubic yards were dredged.

At *Man-of-War Shoal* 85,917 cubic yards were dredged in the years 1878–1880.

At *Mystic River Shoal*, during the years 1879–1882, 82,082 cubic yards were dredged.

During the fiscal year ending June 30, 1889, operations were in progress under the contract of June 22, 1888, and the supplementary agreement of October 27, 1888, with Mr. G. W. Townsend for the removal of ledges from the channel near Lower Middle Shoal. The contract was satisfactorily completed May, 1889, by the removal of 375 cubic yards of ledge. The main ship-channel, opposite the "Lower Middle," is now 1,000 feet wide, 23 feet deep at mean low water.

The river and harbor act of August 11, 1888, provided that \$62,500 "shall be used in widening the main ship-channel at the Upper and Lower Middles."

Specifications and advertisements for this work, specifically appropriated for, were prepared and issued. The bids received were opened November 8, 1888. A copy of the proposals will be found in the annexed table.

On November 23, 1888, a contract was entered into with the New England Dredging Company to remove 170,000 cubic yards, more or less, from the "Upper and Lower Middles."

Operations under this contract were commenced in December, 1888, and continued until May 3, 1889. A total of 146,556 cubic yards were removed, when operations were suspended until surveys and estimates could be made for the removal of small ledges uncovered by the dredging.

On June 30, 1889, the main ship-channel was 23 feet deep at mean low water, 1,100 feet wide west of the Upper Middle, 750 feet wide at

Upper Middle, 1,000 feet wide at the Lower Middle, and 625 feet wide at the Narrows.

To complete the project for the improvement of the main ship-channel will require an appropriation of \$200,000, all of which could be expended to advantage during the fiscal year ending June 30, 1891.

In the project of August 24, 1888, which was approved September 6, 1888, for the expenditure of the appropriation made for this harbor by the act of August 11, 1888, it was proposed to expend \$6,000 for a survey of the main ship-channel east of Long Island head. A general survey covering this area has been made, and the notes have been plotted. Detailed surveys of the ledges and shoals indicated by this general survey will be made during the next fiscal year.

In addition to these improvements of the main ship-channel through the inner and outer harbor, dredging and blasting have been done in the following tributary channels:

I.—CHARLES RIVER.

This river enters the inner harbor near the navy-yard at Charlestown. Before improvement the natural channel had, as far up as Western Avenue Bridge, $4\frac{1}{2}$ miles from its mouth, 7 feet depth at mean low water, except in several places, covering about $1\frac{1}{2}$ miles in extent below Brookline Street Bridge, where the depth varied from $4\frac{1}{2}$ to 7 feet. From Western Avenue Bridge up to Arsenal Street Bridge ($2\frac{1}{2}$ miles) there was a depth of 4 feet, mean low water; thence to Market Street Bridge ($\frac{3}{4}$ mile) $2\frac{1}{2}$ feet mean low water; and thence to the dam at the head of tide-water ($1\frac{1}{2}$ miles) a depth varying from 0 to $9\frac{1}{2}$ feet above mean low water. The mean rise or fall of the tides is 10 feet. A sketch showing the river was published in the Annual Report of the Chief of Engineers for 1884, page 512.

The project for the improvement of this river consists in straightening, widening, and deepening the natural channel, so that it should be, from its mouth to Western Avenue Bridge, 7 feet deep at mean low water and 200 feet wide; from Western Avenue Bridge to Market Street Bridge 6 feet deep at mean low water and 80 feet wide; thence to the dam at the head of tide-water 60 feet wide and 2 feet deep at mean low water.

The estimated cost of this improvement was originally \$85,000. A revised estimate was submitted in 1881 of \$125,000.

The total appropriations for this improvement to date have been \$57,500.

The total expenditures to June 30, 1888, were \$57,378.99.

No operations were in progress during the fiscal year, and the condition of the improvement June 30, 1889, was as follows: The projected channel had been completed from the mouth of the river to Arsenal Street Bridge ($7\frac{1}{4}$ miles); work was stopped at this point for the reason that the draws and piers of this bridge do not conform to the projected channel above it. In effecting this improvement 127,971 cubic yards were dredged during the years 1880-1884.

This improvement, even if the project were completed, is not regarded as an important benefit to commerce, for the conditions which exist on the lower reach of the river between Boston, Cambridge, and Charlestown make navigation of most any kind extremely expensive, slow, and difficult. Seven railroad and municipal bridges now exist on this lower part of the river, and an eighth is being built on the extension of West Chester Park street, under authority of a State act. The

funds available July 1, 1889, will be expended in surveys and examinations of the work.

II.—FORT POINT CHANNEL.

This channel is situated between the eastern shore of Boston proper on the one side and the reclaimed and improved flats of South Boston and South Boston on the other side. It connects the tidal basin of South Bay, which has an area of 250 acres, with Boston inner harbor, is fast becoming the center of the city's most extensive shipping trade, and is the most important branch of the main ship-channel. Fort Point Channel is $1\frac{1}{2}$ miles long. Before improvement the least depth at mean low water was 12 feet at its entrance and 17 feet above Congress Street Bridge. That part of it which it is proposed to improve is spanned by bridges at Congress street, Mt. Washington avenue, and at an intermediate point. These bridges have conveniently located draw-openings, but the draw-piers of the railroad bridge must be strengthened or reconstructed before the improvement can be extended past them, and the width of the draw increased to that of the other bridges above and below it.

The project for this improvement was submitted January 27, 1885, Annual Report Chief of Engineers, 1885, page 545.

It proposed the excavation of a channel 175 feet wide and 23 feet deep at mean low water from the entrance to near Federal Street Bridge, a distance of 4,100 feet, and was estimated to cost \$100,000; the railroad bridge to be constructed at the expense of the owners.

By the river and harbor act of August 5, 1886, the sum of \$18,750 was appropriated for the improvement of that part of the channel lying below Congress Street Bridge.

The total expenditures to June 30, 1888, were \$17,439.50.

No operations were in progress during the fiscal year, and the condition of the improvement on June 30, 1889, was as follows: The channel had been dredged as proposed from its entrance to Congress Street Bridge, a distance of 1,900 feet; 94,211 cubic yards were removed in effecting this improvement during the year 1887.

The funds available July 1, 1889, will be expended in examinations of the work. To complete the improvement as proposed to Federal Street Bridge will cost \$60,000, and this sum could be expended to advantage during the fiscal year ending June 30, 1891, if the railroad draw shall have been properly reconstructed.

III.—HINGHAM HARBOR.

See separate report.

IV.—NANTASKET BEACH CHANNEL.

This is a small channel along the east side of Hingham or Hull Basin. It leads to a wharf on the west side of the heel of Nantasket Beach, about 12 miles from Boston.

Before improvement it was approximately 100 feet wide and had a depth of at least 11 feet, except at the eastern end, 1,500 feet from the wharf, where the width was reduced to 40 to 50 feet and the depth to less than 8 feet. It was circuitous and obstructed by bowlders at the mouth of Weir River and by a ledge near the wharf.

The project adopted in 1880 was to widen and deepen the channel from the mouth of Weir River to the steam-boat wharf, so that it would

be 100 feet wide and $9\frac{1}{2}$ feet deep at mean low water; to remove a few boulders at the mouth of Weir River, and to remove the ledge near the wharf.

The total appropriations and allotments for this work to date have been \$11,750.

The total expenditures to June 30, 1888, were \$11,750.

The condition of the improvement June 30, 1888, was as follows:

The projected channel had been completed by the removal of 41,922 cubic yards of material dredged, and 54 cubic yards of ledge blasted during the years 1881-'83.

The act of August 11, 1888, provided for an examination of this channel. It was made and a report submitted October 27, 1888. This report stated that the locality was worthy of improvement, and an allotment of \$300 was recommended for a survey.

No other operations have been in progress during the fiscal year, and the condition of the improvement is the same as on June 30, 1888.

V.—CHANNEL BETWEEN NIX'S MATE AND LONG ISLAND.

This is a channel through the bar which extends from the north head of Long Island to Nix's Mate Shoal. Previous to the improvement there was $4\frac{1}{2}$ feet depth of water on the bar at mean low tide.

The project for the improvement was adopted in 1883. It was to dredge a channel 200 feet wide, 12 feet deep at mean low water, and about 550 feet long. In 1887 it was recommended that the axis of the cut be shifted 30 degrees to the westward and that it be widened to 300 feet, 15 feet deep at mean low water.

The original project was estimated to cost \$9,000. The project of 1887 was estimated to cost \$25,000.

No specific appropriation has been made for this work.

The expenditures on it to June 30, 1888, from the appropriation for the improvement of Boston Harbor, were, for dredging, \$9,551.76. No operations were in progress during the fiscal year, and the condition of the improvement on June 30, 1889, was as follows:

The original project had been completed by the removal of 19,899 $\frac{1}{2}$ cubic yards of material during the year 1884.

The latest survey shows that the channel has retained its full width, and deepened throughout one foot approximately. The channel has been of the greatest service to the vessels and boats which ply to the wharves of the lower harbor, and has conferred a great benefit upon commerce by diminishing the number of passages of medium craft through the "Narrows," where the channel is narrow and overburdened, and the currents transverse and irregular. These advantages will be largely increased so soon as the modified project of 1887 shall have been completed. The estimated cost of this modified project is \$25,000, all of which could be expended to advantage during the fiscal year ending June 30, 1891.

VI.—BROAD SOUND.

An obstruction called Barrel Rock, lying on the north side of the Broad Sound Channel, was removed in 1869. It contained 116 cubic yards.

The balance available for the improvement of Boston Harbor on July 1, 1889, will be expended in completing the extension of the Gallop's Island sea-wall, in repairing the sea-walls at Deer Island, in completing the survey of the outer harbor, and in removing from the "Upper Middle" the small ledges uncovered by the dredging.

Recapitulation of amounts which could be expended to advantage during the fiscal year ending June 30, 1891.

Extension of Point Allerton sea-wall.....	\$15,000.00
Repair of Great Brewster Island sea-wall.....	10,000.00
Sea-wall for George's Island.....	35,000.00
Extension of Gallop's Island sea-wall.....	12,000.00
Extension of Long Island sea-wall.....	3,000.00
Sea-walls for Governor's Island.....	80,000.00
Widening main ship-channel at the "Upper Middle".....	200,000.00
Completion of Fort Point channel.....	60,000.00
Completion of channel between Nix's Mate and Long Island.....	25,000.00
Total.....	440,000.00

The several works completed and projected for the improvement of this harbor are located in the collection district of Boston and Charlestown, Massachusetts. Boston is the port of entry.

The accompanying commercial statistics for the fiscal year ending June 30, 1889, have been furnished by the collector of customs at Boston, Mass.:

Money statement.

July 1, 1888, amount available.....	\$3,129.26
Amount appropriated by act of August 11, 1888.....	125,000.00
	<u>128,129.26</u>

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$70,438.54
July 1, 1889, outstanding liabilities.....	6,964.30
July 1, 1889, amount covered by existing contracts.....	8,205.40
	<u>85,628.24</u>

July 1, 1889, balance available.....	<u>42,501.02</u>
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{ Amount (estimated) required for completion of existing project.....	440,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891.....	440,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for delivery of granite ashlar at Gallop's Island, Boston Harbor, Massachusetts, opened November 3, 1888, by Maj. John P. Hawkins, C. S., U. S. A., during the official absence of Lieut. Col. G. L. Gillespie, Corps of Engineers.

No.	Names of bidders.	Prices bid for 300 feet granite ashlar per running foot.						Aggregate amounts bid.
		1 foot 10 inches rise.	1 foot 11 inches rise.	2 feet rise.	2 feet 1 inch rise.	2 feet 3 inches rise.	300 square yards shell stone, per square yard.	
1	Rockport Granite Company.*	.....	.....	.....	.....	.....	\$0.79	\$5,012.00
2	Charles H. Edwards.†	.....	.....	.....	.....	.....	.....	7,645.00
3	Pigeon Hill Granite Company.‡	.....	.....	.....	.....	.....	.....	4,747.00
4	Thomas A. Kowet.	.....	.....	.....	.....	.....	.....	7,149.00
5	George Willet Andrews.	\$2.49	\$2.49	\$2.49	\$2.49	\$5.87	2.28	5,433.00
6	Edwin Canney §	.....	.....	.....	.....	.....	1.35	5,502.63
7	James J. Vernon†	.....	.....	.....	.....	.....	.....	6,224.00
8	George M. Nealon**	.....	.....	.....	.....	.....	.....	5,648.00
9	Francis H. Smith††	.....	.....	.....	.....	.....	.....	7,620.00
10	Mount Waldo Granite Works.‡‡	.....	.....	.....	.....	.....	.....	6,233.00

* \$15.91‡ per linear foot for five courses.

† Lowest bid.

‡ Approximate amount, bid indefinite.

** \$16 per cubic yard for five courses.

† For all stone as per specifications.

§ \$5,098.63 for five courses complete.

‡‡ Granite as per advertisement.

†† 80 cents per cubic foot.

Contract awarded to the Pigeon Hill Granite Company, with the approval of the Chief of Engineers.

Abstract of proposals for dredging in Boston Harbor, Massachusetts, opened November 8, 1888, by Maj. W. S. Stanton, Corps of Engineers, during the official absence of Lieut. Col. G. L. Gillespie, Corps of Engineers.

No.	Names of bidders.	Price bid per cubic yard for—	
		Dredging measured in scows.	Removal of bowlders weighing over 6 tons each.
*1	Augustus R. Wright	<i>Cents.</i> 37½	\$15.00
†2	New England Dredging Company, by Charles H. Souther, president...	25	118.00

* To commence at once.

† For bowlders over 3 tons each.

‡ To commence on or before December 1, 1888; lowest bid.

Contract awarded to the New England Dredging Company, with the approval of the Chief of Engineers.

Transactions of commerce and navigation at the port of Boston.

Importations:		
Merchandise		\$66, 731, 023
Coin and bullion		\$39, 411
Domestic exportations, merchandise		\$65, 893, 210
Foreign exportations (returned exports), merchandise		\$967, 010
Vessels entered from foreign ports:		
Number		2, 370
Tonnage		1, 399, 484
Vessels cleared for foreign ports:		
Number		2, 474
Tonnage		1, 221, 842
Total customs collected from all sources		\$20, 830, 733.32

B II.

IMPROVEMENT OF HARBOR AT HINGHAM, MASSACHUSETTS.

Hingham Harbor is situated in the southern part of Hingham or Hull Basin, which comprises all that part of Boston Lower Harbor south of Nantasket Roads. A chart of the harbor was published in the Annual Report of the Chief of Engineers for the year 1888, Part I, page 456.

The harbor covers an area of one square mile, and has extensive mud flats, bare at low tide. The mean rise or fall of the tide is 9.4 feet.

The channel leading to Hingham south of Ragged and Sailor's islands was, before improvement, very narrow and crooked and obstructed by sunken rocks and shoals. Its least width was 30 feet, and least depth 4 feet at mean low water.

The object of its improvement is to widen and deepen the natural channel from deep water near the head of the harbor to the steam boat wharf, a distance of 2,500 feet.

The original project for improvement was submitted December 23, 1874. It provided for an improved channel on the east side of Sailor's Island, past the west side of Beacon to the Hingham Wharf, 100 feet wide and 8 feet deep at mean low water, at an estimated cost of \$11,000. This project was modified January 20, 1885, when it was proposed to deepen the improved channel to 10 feet at mean low water, and to remove a mid-channel ledge lying between Chandler's and Ragged islands, measuring 128 cubic yards, at a total cost of \$18,700.

The total amount appropriated for this harbor to date is \$21,000.

The total expenditures to June 30, 1888, were \$16,000.

The condition of the improvement on June 30, 1888, was as follows: The original project had been completed, and the modified project of 1885 had been partly completed, by dredging and blasting the channel 10 feet deep and 50 feet wide, through the ledge, which extends for 280 feet in length in the improved channel, about 1,600 feet northeast of the steam-boat wharf.

On August 24, 1888, a project was submitted for the expenditure of \$5,000, made available for this improvement by the river and harbor act of August 11, 1888. This project proposed to enlarge the cut through the ledge, 1,600 feet northeast of the steam-boat wharf, to its full projected dimensions, 100 feet wide and 10 feet deep at mean low water, 280 feet long. This project was approved September 10, 1888.

Specifications and advertisement for this work were prepared and issued, and the bids received were opened November 2, 1888. A copy of the proposals received will be found in the annexed table.

On November 15, 1888, a contract was entered into with Mr. Geo. W. Townsend for the removal of 200 cubic yards of ledge, more or less, at \$25 per cubic yard. The contract expires December 31, 1889. Operations under it were commenced in May, 1889, and 80 cubic yards were removed during the year ending June 30, 1889. To complete the project will require an appropriation of \$8,000, all of which could be expended to advantage during the fiscal year ending June 30, 1891. The benefit to be expected from the completion of this improvement is a more convenient and safe navigation of the improved channel.

Hingham Harbor is in the collection district of Boston, Mass. The nearest light-house is the Narrows light on the main ship-channel in Boston Harbor, distant about 5 miles.

Commercial statistics included in Boston Harbor.

Money statement.

Amount appropriated by act of August 11, 1888.....	\$5,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$142.68
July 1, 1889, outstanding liabilities.....	2,155.00
July 1, 1889, amount covered by existing contracts.....	2,000.00
	<hr/>
	4,297.68
July 1, 1889, balance available.....	702.32
	<hr/>
{ Amount (estimated) required for completion of existing project.....	8,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	8,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for the removal of ledge from the harbor at Hingham, Mass., opened November 2, 1888, by Lieut. Col. G. L. Gillespie, Corps of Engineers.

No.	Names of bidders.	Price bid for the removal of—	
		Rock per cubic, and measured in situ,	Loose material overlying the rock, per cubic yard.
1	Hiram W. Phillips.....	\$27.00	\$6.00
2	Boynton Bros.....	29.00	1.25
3	Thomas A. Rowe.....	28.75	2.15
*4	George W. Townsend.....	25.00	2.00

* Lowest bid for removal of rock. No loose material.

Contract awarded to George W. Townsend, with the approval of the Chief of Engineers.

B. 12.

IMPROVEMENT OF HARBOR AT SCITUATE, MASSACHUSETTS.

Scituate Harbor is on the west shore of Massachusetts Bay, 14 miles from either Boston or Plymouth light-house, and just southwest of the direct sailing course of all ocean-going vessels entering Boston Harbor.

Before improvement the harbor had a low-water area of 57 acres approximately, more than 6 acres of which had a depth of at least 3 feet at mean low water. It was entirely open to the action of easterly winds, and the entrance was obstructed by many sunken bowlders. The depth on the bar was about 2½ feet at mean low water, and the mean rise or fall of the tide is 8.9 feet.

A plan of the harbor, showing the proposed improvement, was published in the Annual Report of the Chief of Engineers for 1881, Part I, page 522.

The object of the improvement is to create a harbor of refuge for vessels bound to Boston, that are too far south of their course to clear the dangerous ledges near Minot light-house.

The project for the improvement adopted in 1881 is to build two rubble-stone breakwaters converging towards each other from opposite banks, and to dredge an anchorage basin with channels connecting with the sea and the town wharves. The north breakwater from Cedar Point is to be 800 feet long, and the south breakwater, from the point of the "First Cliff," is to be 730 feet. Both breakwaters are to be 20 feet wide on top and 4 feet above mean high water except at their outer ends, which are to be built 6 feet higher to serve as sites for entrance beacons.

The anchorage basin to be 30 acres in area, approximately. The entrance channel to be 2,700 feet in length and 300 feet average width. The estimated amount of dredging (including the entrance channel) was 500,000 cubic yards; to give a depth of 15 feet at mean low water in the entrance channel; 12 to 15 feet between the breakwaters; 12 feet immediately in rear of the south breakwater, and 10 feet for the anchorage basin. The estimated cost of the breakwater was \$100,000, and of the dredging \$190,000, a total of \$290,000.

The total amount appropriated for this work to date is \$52,500. The amount expended to June 30, 1888, was \$47,500. The condition of the improvement June 30, 1888, was as follows: The north breakwater was 720 feet long, of full width and height; the entrance channel was 100 feet wide, 1,600 feet long, and 5 feet deep at mean low water. The anchorage basin was 400 by 350 feet in area, 7 feet deep at mean low water. Nothing had been done on the south breakwater. A portion of the beach between Cedar Point and the mainland was protected by a brush and stone bulkhead 450 feet long, in front of which was a stone apron 10 feet wide, 385 feet long. All known bowlders obstructing the entrance of the harbor were removed.

On August 24, 1888, a project was submitted for the expenditure of the sum of \$5,000, made available for this improvement by the river and harbor act of August 11, 1888. This project proposed to dredge a channel 25 feet wide and three feet deep at mean low water to connect the basin with the town wharves.

This project was approved by the Chief of Engineers, September 7, 1888.

Specifications and advertisement for this work were prepared and issued, and bids opened November 2, 1888. A copy of the proposals received will be found in the annexed table.

A contract was entered into with Messrs. Boynton Bros., on November 26, 1888, to dredge 9,000 cubic yards, more or less, scow measurement, from the channel leading from the basin to the town wharves, thereby making it 25 feet wide, 1 foot deep at mean low water. This contract expires December 31, 1889, and no operations under it have been in progress during the year ending June 30, 1889.

No other operations have been in progress during the fiscal year, and the condition of the beach protection, and of the improved channel and basin, and of the north breakwater, is essentially the same as at the date of the last report.

The amount required to complete the improvement is \$237,500. Of this amount \$50,000 could be profitably expended during the fiscal year ending June 30, 1891, as follows:

Build south breakwater, 400 feet long, 10,000 tons rubble, at \$2.15	\$21,500
Enlarge anchorage basin to 4 acres, 10 feet deep, and the channel to the town wharves to 150 feet wide, with the same depth; 70,000 cubic yards of dredging, at 33 cents	23,100
Contingencies	5,400
Total	50,000

Scituate is in the collection district of Plymouth, Mass. The nearest port of entry is Plymouth, Mass. The nearest light-house is Minot's light, about 5 miles distant.

The accompanying commercial statistics have been furnished by the collector of customs at Plymouth, Mass.

Money statement.

Amount appropriated by act of August 11, 1888	\$5,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$46.08
July 1, 1889, amount covered by existing contracts	4,050.00
	<hr/> 4,096.08
July 1, 1889, balance available	903.92
Amount (estimated) required for completion of existing project	237,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1891	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in Scituate Harbor, Mass., opened November 2, 1888, by Lieut. Col. G. L. Gillespie, Corps of Engineers.

No.	Names of bidders.	Price bid for—	
		Dredging per cubic yard measured in scows.	Removal of bowlders weighing over 3 tons each, per cubic yard.
		<i>Cents.</i>	
1	Augustus R. Wright.....	44	\$10
*2	Boynton Bros.....	45	12
3	Bay State Dredging Company, A. B. Martin, proprietor.....	55	15

* Lowest bid.

Contract awarded to Messrs. Boynton Brothers, with the approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

Domestic entrances, 11; tonnage, 1,925; value, \$17,500. Domestic clearances, 11; tonnage, 1,925; tons of coal entered, 1,200; feet of lumber entered, 550,000; exports, 10,000 barrels of sea-moss valued at \$35,000.

The vessels frequenting the port are schooners of not above 7 feet draught.

B 13.

IMPROVEMENT OF HARBOR AT PLYMOUTH, MASSACHUSETTS.

Plymouth Harbor is situated 30 miles south of Boston. Its outer anchorage, the "Cow Yard," is common to Plymouth, Kingston, and Duxbury, and is the only refuge for sea-going vessels from northeasterly gales when caught between Boston and Provincetown, a distance of about 75 miles, following the coast line. The entrance to this outer anchorage is direct, unobstructed, and of ample width, and sufficiently deep for the wants of commerce. The anchorage is capacious, and has good "holding-ground," but the extensive tidal basins inside of it give rise to strong variable currents across it.

The inner or harbor proper is formed by Long Beach, a narrow, low sand-spit 3 miles long, which runs generally parallel to the mainland and about a mile from it.

The harbor contains 2,000 acres, almost all of which is dry at low tide. A few narrow, crooked, shallow channels traverse these flats. These channels join about the center of the harbor, opposite the town wharves, and form the main ship-channel, 150 feet wide, approximately, and 10 feet deep at mean low water, which runs directly behind the northern half of Long Beach to the outer anchorage.

The maintenance of this inner harbor and channel depends on the preservation of Long Beach.

Before improvement about 6 inches depth of water could be carried to the town wharves at low tide.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for the year 1888, Part I, page 460.

Previous to 1875 the project was a general one, and had for its object the *preservation* only of Long Beach. From the nature of the work it can at no time be considered completed, and small annual appropriations are necessary to repair any damage done by storms. The various devices employed for this purpose are described in the Annual Report of the Chief of Engineers for 1877, all of which have been remarkably successful.

The project for the *improvement* of the harbor was first adopted in 1875. It provided for dredging a channel from the town wharves to the main ship-channel, 2,286 feet long, 100 feet wide, and 6 feet deep at mean low water. This project was modified in 1877 so as to include the dredging of a basin 866 feet long, 150 feet wide, and 8 feet deep, directly in front of the town wharves.

In 1884 and 1885 it was proposed to deepen the improved channel and basin to 9 feet at mean low water, and to make the approaches more easy.

The modified project of 1884 required the excavation of 81,000 cubic yards (scow measurement), and was originally estimated to cost \$27,000. This estimate was revised in 1885, in accordance with the low prices then current for dredging, and the cost was then estimated to be \$22,500.

From 1866 to date the amount appropriated for this improvement was \$120,800, of which there had been expended to June 30, 1888,

For beach protection.....	\$72,567.56
For dredging etc	42,212.44
Total	114,800.00

The condition of the improvement on June 30, 1888 was as follows: The improved channel was 115 feet in width, 9 feet in depth at mean low water; the basin was 800 feet in length, 9 feet in depth for 90 feet of its width nearest the town wharves, and the remainder averaged 5 feet in depth; Long Beach was in good order throughout, and the works of preservation on it required no repairs or extension.

On August 24, 1888, a project was submitted for the expenditure of the sum of \$6,000 made available for this improvement by the river and harbor act of August 11, 1888.

This project proposed to reserve \$1,000 for probable necessary repairs to Long Beach, and to expend \$5,000 in enlarging "the basin" to its full projected dimensions.

This project was approved September 14, 1888. Specifications and advertisement for the proposed work were prepared and issued, and bids received were opened November 1, 1888. A copy of the proposals received will be found in the annexed table.

A contract was entered into with Mr. Augustus R. Wright on November 26, 1888, to dredge 13,000 cubic yards, more or less, from "the basin" at 29½ cents per yard, scow measurement. This contract expires December 31, 1889, and no operations have been in progress under it during the fiscal year.

In November, 1888, an easterly storm caused four serious breaches in the northern part of Long Beach; they were at once closed with plank bulkheads aggregating 370 feet in length. This work was done by hired labor and cost \$444.17.

On June 30, 1889, the improved channel and basin are in the same condition essentially as at the close of the last fiscal year. Some repairs and extensions to the existing bulkheads on Long Beach are required, which it is estimated will cost \$1,500.

To complete the project will require, at present rates for dredging, an appropriation of \$14,500.

A small sum should always be available for the harbor, to immediately repair any damage made by storms to Long Beach. These necessary repairs have in the last twenty years averaged \$1,500.

During the fiscal year ending June 30, 1891, an appropriation of \$17,500 could be expended to advantage for dredging, for necessary repairs and extensions of the present bulkheads on Long Beach, and for the repair of probable storm damages.

The prospective benefits to commerce are increased facilities and safety in navigating the improved channel.

Plymouth Harbor is located in the collection district of Plymouth, Mass., of which Plymouth is the port of entry.

The nearest light-houses are the Plymouth (Gurnet) lights about 5 miles from Plymouth, and Duxbury Pier Light, about 2 miles distant.

The accompanying commercial statistics for the fiscal year ending June 30, 1889, have been furnished by the collector of customs at Plymouth, Mass.

Money statement.

Amount appropriated by act of August 11, 1888.....	\$6,000. 00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$502. 75
July 1, 1889, amount covered by existing contracts.....	3, 883. 75
	4,386. 50
July 1, 1889, balance available.....	1, 613. 50
{ Amount (estimated) required for completion of existing project.....	17, 500. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	17, 500. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in Plymouth Harbor, Mass., opened November 1, 1888, by Lieut. Col. G. L. Gillespie, Corps of Engineers.

No.	Name of bidder.	Price bid for—	
		Dredging per cubic yard, measured in scows.	The removal of bowlders weighing over 3 tons, per cubic yard.
		<i>Cents.</i>	
*1	Augustus R. Wright.....	29½	\$10
2	National Dredging Company, by George G. Barker, vice-president....	30	.....
3	Bay State Dredging Company, by A. B. Martin, proprietor.....	35	.....
14	Boynnton Bros.....	32	12

* Lowest bid.

† Bid informal.

Contract awarded to Augustus R. Wright, with the approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

Shipping.	Foreign.			Domestic.		
	Number.	Tonnage.	Value.	Number.	Tonnage.	Value.
Entrances	4	1,329	\$67,663	117	17,012	\$185,585
Clearances	5	1,523	5,790	119	17,165	.....
Amount of revenue collected	\$100,562.58					
Coal imported..... tons..	20,897					
Iron imported..... do..	450					
Cordage exported (value \$45,900) tons	320					
		Merchandise..... tons..	463			
		Miscellaneous imports..... do ...	650			
		Lumber imported..... feet..	4,055,009			
		Value of machinery exported.....	\$5,790			

The vessels frequenting the port are principally schooners from 8 to 12 feet draught

B 14.

IMPROVEMENT OF HARBOR AT WELLFLEET, MASSACHUSETTS.

Wellfleet Harbor is situated on Cape Cod Bay, 12 miles southeast of Provincetown Harbor.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for the year 1888, Part I, page 478.

The harbor consists of an outer anchorage south of Smalley's Bar, and an inner harbor north of the same bar.

The outer anchorage is sufficiently capacious, free from obstructions, and protected, to meet the present demands of commerce, but the inner harbor, although capacious and perfectly protected, has no low-water navigable connection with the town wharves.

It is 4,200 feet from the 6-foot contour to the wharves, and not to exceed 6 inches draught can be carried to them at mean low water.

The original project for the improvement of this harbor was submitted November 3, 1871. It was based on the survey provided for in the river and harbor act of January 31, 1871. It proposed to dredge two channels, each 150 feet wide and 4 feet deep at mean low water; one 2,060 feet long to reach "Central" and "Commercial" wharves, and one 1,400 feet long, to reach "Mercantile" Wharf. It was also proposed to remove 204 cubic yards of sunken rocks. The cost of this project was estimated to be \$30,000.

On November 28, 1887, a revised project was submitted. It was based on the survey provided for in the river and harbor act of August 5, 1886. It proposed to dredge a channel from the "Deep Hole" to the town wharves, 6 feet deep at mean low water, 100 feet wide, and 4,200 feet long, at an estimated cost of \$24,000.

The total appropriations for this harbor to date have been \$12,000.

By the river and harbor act of June 10, 1872	\$5,000
By the river and harbor act of August 11, 1888	7,000
Total.....	12,000

The total amount expended to June 30, 1888, was \$5,000, and the condition of the improvement on that date, was as follows: "Mayo Bay," "Lobster," and "Lumpfish" rocks had been removed, and no low-water channel existed to the town wharves. On August 24, 1888, a project was submitted for the expenditure of the funds made available for this improvement, by the river and harbor act of August 11, 1888. This

project was to dredge a channel from the "Deep Hole" to the town wharves, 4,200 feet long, 25 feet wide, and 6 feet deep at mean low water. This project was approved by the Secretary of War September 11, 1888.

Specifications and advertisement for this work were prepared and issued, and the bids received were opened November 3, 1888. A copy of the proposals will be found in the annexed table.

On November 26, 1888, a contract was entered into with Mr. A. R. Wright to dredge 18,000 cubic yards at 34½ cents per yard, scow measurement, from the proposed channel connecting the "Deep Hole" with the town wharves, making it 2,500 feet long, 4 feet deep at mean low water, and 25 feet wide.

This contract expires December 31, 1889, and no operations have been in progress under it during the year ending June 30, 1889. No other operations have been in progress and the condition of the improvement remains the same as on June 30, 1888. To complete the improvement will require at the present prices for dredging an appropriation of \$26,000, all of which could be expended to advantage during the fiscal year ending June 30, 1891.

The prospective benefits to commerce are increased facilities in navigating the inner harbor.

The accompanying commercial statistics for the fiscal year ending June 30, 1889, have been furnished by the collector of customs at Barnstable, Mass. The nearest light-house is upon Billingsgate Island.

Money statement.

Amount appropriated by act of August 11, 1888	\$7,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$43.54
July 1, 1889, amount covered by existing contracts	6,210.00
	<u>6,253.54</u>
July 1, 1889, balance available	<u>746.46</u>
{ Amount (estimated) required for completion of existing project	26,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	26,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in Wellfleet Harbor, Mass., opened November 3, 1888, by Maj. John P. Hawkins, U. S. A., during the official absence of Lieut. Col. G. L. Gillespie, Corps of Engineers.

No.	Name of bidder.	Price bid for—	
		Dredging per cubic yard measured in scows.	The removal of bowlders weighing over 3 tons each per cubic yard.
1	Bay State Dredging Company, A. B. Martin, proprietor	Cents. 37	\$10
2	Boynton Brothers	40	12
13	Augustus R. Wright	{ 34½ } { 42 }	{ 10 }

* Price for dredging if material can be dumped inside.

† Lowest bid.

‡ Price for dredging if material has to be towed to sea.

Contract awarded to Augustus R. Wright, with the approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

The amount of revenue collected was \$157.50.

Shipping.	Foreign.			Domestic.		
	Number.	Tonnage.	Value.*	Number.	Tonnage.	Value.*
Entrances	1	75	\$3,000	18	1,250	\$75,000
Clearances	1	75	3,000	20	1,750	100,000

* Estimated.

Coal imported.....	tons..	1,365	Lumber imported	feet..	20,00
Salt exported	bushels..	16,000	Value of merchandise imported.....		\$47
Iron imported	tons..	10	Value of miscellaneous imports.....		\$16

The vessels frequenting the port are schooners, mostly fishing-vessels, from 5 to 10 feet draft. Their value is estimated at \$1,500,000.

B 15.

IMPROVEMENT OF HARBOR AT PROVINCETOWN, MASSACHUSETTS.

Provincetown Harbor is situated at the extremity of Cape Cod, about 40 miles southeast from Boston Light.

It is one of the most valuable harbors of refuge on the Atlantic coast. The entire commerce of New England, and a very large local fishing interest, are directly benefited by its maintenance, which depends entirely on the preservation of the sandy beaches which inclose it.

Since 1826 the project has been a general one, and provides for the preservation of the harbor by building dikes, bulkheads, and sand-catches, and extensive planting of beach grass, to repair or prevent storm damages to the beaches. From the nature of the work it can at no time be considered completed.

A full history of the improvements will be found in the Annual Reports of the Chief of Engineers for the years 1876, 1879, and 1886. A special dike across House Point Island Flats, to be built contingently, was recommended in the Annual Report for 1886. A plan of the harbor was published in the Annual Report of the Chief of Engineers for 1886.

The total appropriations or allotments for this work up to date have been \$146,478.44. The amount expended up to June 30, 1888, was \$139,328.09.

The condition of the improvement on June 30, 1888, was as follows:

LONG POINT.

This long, narrow, low point forms the southeastern limit of the harbor. It had been protected on the east, or outside, by bulkheads, groins, and aprons, built of rubble-stone. These were all generally in good order, except that 600 tons of additional large stone were required to level up the bulkhead near the northern end; and it required to be repaired and backed with brush and small stone to prevent the sea making through it, to the injury of the beach behind it. The brush bulkhead near Wood End Light was in good order.

On August 24, 1888, a project was submitted for the expenditure of the funds appropriated for this improvement by the river and harbor act of August 11, 1888.

This project was approved September 6, 1888. It proposed to reserve \$1,000 for the repair of probable storm damage to the existing works, and to expend the balance of the appropriation in leveling up and backing the Long Point Breakwater; material to be purchased by contract; the work to be done by hired labor.

Specifications and advertisement were prepared and issued for the necessary material; the bids received were opened November 2, 1888; a copy of the proposals will be found in the annexed table.

On November 24, 1888, a contract was entered into with Mr. Charles H. Edwards to deliver 600 tons of large stone in place on the breakwater, and 700 tons small stone and 150 cords of brush on the beach inside of the light. The contract expires December 31, 1889.

Operations were commenced under this contract in April, 1889, and during the fiscal year 341 tons of large stone, 428 tons of small stone, and 135 cords of brush were delivered.

A small force of hired men have been employed in placing this brush and small stone in rear of the breakwater, and at the date of this report 300 feet of the breakwater was backed.

On the completion of this contract, the northern extremity of Long Point will be fully protected from easterly storm action; but the north-western part of the point, opposite the fog-signal station, has for some time been more or less abraded by storms, and, to secure the light-house tract, it may be necessary to extend the breakwater 250 feet to the west and south.

That part of Long Point lying between 2,000 and 4,000 feet west of Wood End Light has for many years been narrowing. In 1835 it was 130 feet wide between the extreme high-water lines, and in 1888 it was but 40 feet, a reduction in width of 90 feet, nearly all of which has been worn from the inside beach by northeasterly storms. This 2,000 feet of beach should be protected on the inside by a plank bulkhead with groins connecting with the grassed beach in the rear. This will cost \$6,000, and this amount could be expended to advantage during the fiscal year ending June 30, 1891.

ABEL HILL DIKE.

This dike was built to prevent the rush of water from Lancey's Harbor over House Point Island Flats into the main harbor.

The rapid wearing away of the southern sand-spit that forms Lancey's Harbor had threatened to make a breach through the beach south of the dike. To guard against this, brush and wooden sand-catches had been built on the outer beach opposite the west end of the dike. They were all in good order.

HOUSE POINT ISLAND FLATS.

These flats remained essentially unaltered from the condition shown by the last survey, and, as stated in the Annual Report for 1887, it still appears unnecessary to commence the dike projected to be built across these flats. The most of the grass planted during the last fiscal year had rooted, and was growing at the date of this report.

BEACH POINT, HIGH HEAD DIKE, AND COVE-SECTION.

These works were all in good order.

During the fiscal year ending June 30, 1889, the only operations in progress were those at Long Point; and at the date of this report the several works of preservation were in good order, and serving the purpose for which they were built. The nature of the works of preservation for this harbor requires a small sum to be always available for immediate repairs. Such necessary repairs have averaged \$1,500 per annum.

The prospective benefit to commerce is the preservation of an important harbor of refuge.

Provincetown is a port of entry in the collection district of Barnstable, Mass. The nearest light-houses are Wood End and Long Point Lights.

The accompanying commercial statistics have been furnished by the deputy collector at the port of Provincetown, Mass.:

Money statement.

July 1, 1888, amount available	\$150.35
Amount appropriated by act of August 11, 1888.....	7,000.00
	<hr/> 7,150.35
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$1,715.18
July 1, 1889, outstanding liabilities.....	654.92
July 1, 1889, amount covered by existing contracts.....	788.78
	<hr/> 3,158.88
July 1, 1889, balance available.....	<hr/> 3,991.47
{ Amount (estimated) required for completion of existing project.....	7,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	7,500.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for the delivery of stone and brush for Provincetown Harbor, Mass., opened November 2, 1888, by Lieut. Col. G. L. Gillespie, Corps of Engineers.

No.	Name of bidder.	Price bid for.		
		Large stone per ton of 2,000 pounds.	Small stone per ton of 2,000 pounds.	Brush per cord.
1	Thomas A. Rowe	\$1.97	\$1.97	\$7.50
*2	Charles H. Edwards	1.38	1.38	4.00
3	Edwin Canney	2.35	2.35	.....
4	Joseph H. White	1.68	1.68	.....
5	Joshua Paine, jr.	3.50	2.75	4.00

* Lowest bid.

Contract awarded to Charles H. Edwards, with the approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

Shipping.	Foreign.			Domestic.		
	Number.	Tonnage.	Value.*	Number.	Tonnage.	Value.*
Entrances	28	3,068	\$306,800	12	4,135	\$563,000
Clearances	28	3,068	303,800	8	3,737	510,000

* Estimated.

Salt exported.....bushels..	18,000	Value of miscellaneous imports	\$3,733.00
Lumber imported ..feet..	20,415	Value of miscellaneous exports	2,168.00
Value of merchandise imported	\$111.50		

All classes of vessels frequent the port. Their average draught is 10 feet. A low estimate of the value of vessels using the harbor for shelter during the year is \$60,000,000.

B 16.

REMOVAL OF SUNKEN VESSELS OR CRAFT ENDANGERING OR OBSTRUCTING NAVIGATION.

On November 14, 1888, report was made that the schooners *Mary* and *Goldsmith Maid* had been wrecked in Boston Harbor, and formed obstructions to navigation. It was recommended that they be removed under authority of section 4, river and harbor act of June 14, 1880. This was approved by the Secretary of War November 24, 1888.

Public notice was issued to the owner or owners of the vessels on November 30, 1888. Specifications and advertisement for the removal of these wrecks were prepared and issued, and the bids received were opened January 4, 1889.

A copy of the proposals received will be found in the annexed table.

On January 14, 1889, a contract was entered into with Messrs. L. E. Lunt & Co. to completely remove the wrecks at a cost of \$1,925. The *Mary* was to be raised and put alongside of the Fort Winthrop Wharf, and the *Goldsmith Maid* dropped in deep water outside of the harbor.

Operations were commenced under the contract on January 23, 1889, and after the site of the wrecks had been swept and examined by a diver, and the contract found to have been completed in a satisfactory manner, final payment was made April 9, 1889.

On April 9, 1889, specifications and advertisement were prepared and issued, calling for proposals for the purchase of the wreck of schooner *Mary*.

The bids received were opened May 15, 1889. A copy of the proposals received will be found in the annexed table.

On May 15, 1889, it was recommended that the highest bid be accepted, and this recommendation was approved May 20, 1889.

Payment was made May 24, 1889, and the wreck was delivered.

Abstract of proposals for the removal of wrecks of schooners Mary and Goldsmith Maid, opened January 4, 1889, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name of bidder.	Prices bid for the removal of wreck of schooner—		Aggregate prices bid.	Time of—	
		Mary.	Goldsmith Maid.		Commencement, 1889.	Completion, 1889.
*1	Harrison Mitchell	\$1,400	\$700	\$2,100	Omitted.....	Omitted.
2	Thomas A. Rowe.....	1,974	600	2,574	January 25.....	February 28.
3	Boston Tow-boat Company.	1,750	1,350	3,100	Twenty-four hours after award.	Within two weeks from time of beginning.
14	L. E. Lunt & Co	1,355	570	1,925	February 1.....	April 1.
5	Nathaniel E. Gordon	1,600	395	1,995	As soon as weather permits.	Within sixty days of beginning.
16	G. A. Lancaster.....	1,500	No bid	.....	Omitted	Omitted.
7	Alexander Crocker	2,475	975	3,450	Immediately after entering into contract.	Within twenty-three days from time of beginning.
8	Lincoln F. Baker	2,000	500	2,500	Omitted	Within sixty days of acceptance of proposals.
9	George W. Townsend	2,492	1,975	4,467	At once	Within thirty days from time of beginning.

* Bid informal; check for \$1,000 deposited as guaranty.

† Bid informal; lowest bid in the aggregate.

‡ Bid informal.

Contract awarded to L. E. Lunt & Co., with the approval of the Chief of Engineers.

Abstract of proposals for the purchase of the wreck of the schooner Mary, Boston Harbor, Mass., opened May 15, 1889, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Names of bidders.	Price bid for wreck.
1	Allan MacDonald.....	\$50
2	L. E. Lunt & Co	127
*3	James Kerrigan.....	251
4	M. J. Drescoll.....	200
5	Edward Q. Rowan.....	65

* Highest bid.

Wreck sold to James Kerrigan with the approval of the Chief of Engineers.
ENG 89—38

B 17.

PRELIMINARY EXAMINATION OF MALDEN RIVER, MASSACHUSETTS, AS TO STRAIGHTENING, WIDENING, AND DEEPENING THE CHANNEL.

UNITED STATES ENGINEER'S OFFICE,
Boston, Mass., October 27, 1888.

GENERAL: In compliance with instructions contained in your circular letter of August 28, 1888, I have the honor to submit this my report of the preliminary examination of Malden River as to straightening, widening and deepening the channel, provided for in the river and harbor act of August 11, 1888. The Malden River is a tidal tributary of the Mystic River, Massachusetts, into which it empties about 3 miles above its mouth at the navy-yard, Boston.

The river is about 2 miles long, and its bed is bare at low tide, except where it has been deepened artificially by the Government or by private individuals.

The natural banks of the river are high salt marshes, rising 10 feet above mean low water, which are overflowed for the greater part at extreme high tides. The mean range of the tides is 9.8 feet. The bed of the channel is soft mud, 3 to 7 feet in depth.

The river is crossed near its confluence with the Mystic River by the Eastern Railroad Bridge, and the Somerville and Malden highway bridge, and near its source at Malden by two highway bridges. All these bridges have draws except the latter. (Commercial statistics are given in Annual Report Chief of Engineers, 1881, Part I, page 534.)

The river and harbor act June 10, 1880, provided for a survey of the river. The survey was made September, 1880, and a report embodying four projects for improvement, two of which provided for straightening and deepening the channel, was submitted to the Department December 1, 1880. (Annual Report Chief of Engineers, 1881, Part I, page 532.)

This survey showed a navigable depth of barely 7 feet at mean high water, the range of tides being 9.8 feet. The project for improvement recommended by the local officer called for a channel to the second bridge, affording 12 feet mean high water, and straightening by cutting across bends at two points, at an estimated cost of \$35,000. The project finally adopted rejected the improvement by cut-offs, and provided for a channel following the natural bed of the river, 12 feet deep mean high water, and 100 feet wide up to the draw-bridge near Malden, and thence 75 feet wide to the next bridge, at an estimated cost of \$35,000, and increased in 1883 to \$47,000.

The river and harbor act of August 2, 1882, appropriated \$10,000, which were applied in accordance with the adopted project, and resulted, 1884, in improving the natural channel for $1\frac{1}{2}$ miles from its mouth with a least width of 50 feet, increased to 70 feet at the turns, and 12 feet deep mean high water.

No further appropriations have been made, and no work has been done since suspension of operations in 1884. The commerce of the insignificant tidal stream is carried in about twenty light scows, and consists principally of coal, lumber, and wood in limited quantities for the supply of a small manufacturing area.

The cost of straightening and deepening the stream to admit of even 12 feet at high-water range of tides 9.8 feet has been estimated at \$37,000. I do not think the tidal water-course, which heads at Malden and traverses wide marsh areas, overflowed at high tides, "worthy of

improvement," and as existing charts already give every requisite information, I do not submit any estimate of the cost of a new survey.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

B 18.

PRELIMINARY EXAMINATION OF COHASSET HARBOR, MASSACHUSETTS.

UNITED STATES ENGINEER'S OFFICE,
Boston, Mass., October 27, 1888.

GENERAL: In compliance with instructions contained in your circular letter of August 28, 1888, I have the honor to submit this my report of the preliminary examination of Cohasset Harbor, provided for in the river and harbor act of August 11, 1888. Cohasset Harbor is a small shallow cove of irregular shape which makes into the shore on the western side of Strawberry Point, $5\frac{1}{2}$ miles southeast of the entrance to Boston Harbor, Mass. The entrance is obstructed seaward by numerous detached rocks and sunken ledges, usually awash at low tide; among the latter is the outer Minot Ledge, the site of the famous Minot's Ledge light-house.

There are three channels, all indifferent, which lead to the harbor, the principal one being the western channel east of Brush Island, which has a width at the entrance of one quarter of a mile and a depth of 13 feet, mean low water. It leads to the outer harbor, inclosed by White Head Sutton Rocks, and Sheppard Ledge, in which the depth is reduced to 8 feet, mean low water, in a small area (Coast Survey Chart, 1878).

The inner harbor is practically dry at low tide, and is connected with the outer harbor by a narrow strait containing about 4 feet, mean low water.

Owing to the rocks at the entrance and the narrowness and shoalness of the channels, it is not safe to try to make the harbor except when the sea is calm, and only possible when the tide is high. The range of tides is 10 feet, approximately. These conditions therefore seriously restrict the usefulness of the harbor.

The fishing trade once centered there made it a place of common resort for about fifty sail of slight draught; this interest has declined to almost extinction, and the harbor is now used by only a few vessels which come at wide intervals and bear no commerce of any importance.

Two wharves in good repair, and others in a declining condition, are located upon the inner harbor for the service of such vessels as enter at high tide.

A personal examination of the harbor has been made, and nothing was observed which indicated that degree of prosperity, existent or prospective, which would recommend any work of improvement by the Government. The special improvement which the ship-owners desire is the opening of a channel from the outer harbor to the wharves of the inner harbor, affording 10 feet depth, mean low water. This would involve an improved channel 1 mile long with a least width of 50 feet and

would cost, it is estimated, for dredging 70,000 cubic yards sand and gravel, free from bowlders or ledges, the sum of \$20,000.

The mere opening of a straight channel through the inner harbor, affording 4 to 5 feet depth, mean low water, would give no special relief in entering the harbor, for the reason that the flats seaward of White Head Cliff have less than 2 feet depth at low water, though it can not be doubted that such an improvement would be a convenience at low tide to such vessels as had entered at high tide. I do not think the harbor "worthy of improvement," and therefore do not submit any estimate of cost for a survey.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

B 19.

PRELIMINARY EXAMINATION OF GOOSE POINT CHANNEL, PLYMOUTH HARBOR, MASSACHUSETTS, TO PUBLIC WHARF AT KINGSTON.

UNITED STATES ENGINEER'S OFFICE,
Boston, Mass., October 27, 1888.

GENERAL: In compliance with instructions contained in your circular letter of August 28, 1888, I have the honor to submit this my report of the preliminary examination of Goose Point Channel, Plymouth Harbor, to public wharf at Kingston, provided for in the river and harbor act of August 11, 1888. Plymouth Harbor is practically composed of three different bays, Duxbury Bay on the north, Kingston Bay on the west, and Plymouth Bay and Harbor on the south. These three bays have a common anchorage at the outer entrance, called the Cow-Yard, from which diverge distinct channels leading to their respective local wharves. Goose Point Channel is a small depression in the Plymouth Flats, and forms the western branch of the Plymouth Harbor main channel. It is somewhat over a mile long, has a width of 180 feet, and a depth at mean low water of 12 feet. It may be regarded as a blind flood-channel, leading nowhere in particular except toward a shoal beach, and is only used at high water by vessels which may desire to go by a direct course to the wharf belonging to the Plymouth Cordage Company, in North Plymouth.

There are only four wharves between Plymouth and Kingston: Robins Wharf and wharf of the Plymouth Cordage Company, North Plymouth; wharf at Rocky Neck, 4,000 feet to the westward, and one inside of Johns River. All of these wharves have a limited use. The first three are on the south shore, and are separated from the deep-water channel of the adjacent bay by wide flats, bare at low water. The Goose Point Channel does not give access to any one of them at any stage of the tide except to small vessels, and to make a communication with one or all of them by a water-way excavated from the terminus of the Goose Point Channel would be to dig a channel along a sloping beach where the existing depth is nowhere greater than $1\frac{1}{2}$ feet at mean low water, and across which the ebb tides would race almost at right angles in their course to the deep water outlet located at the foot of the fore-shore of the beach. It is apparent that such a chan-

nel, once opened, would rapidly decline, and would require constant dredging for its maintenance.

The river and harbor act of July 5, 1884, provides for the examination of "Goose Point Channel in Plymouth Harbor to the wharf of the Cordage Company."

The examination was made in August, 1884, and a report submitted by the engineer officer in charge, dated September 4, 1884 (Annual Report Chief Engineers, 1885, Part 1, page 508). The officer stated in the report that the Goose Point Channel is not a low-water channel, and the opening of a water-way by dredging 5,940 feet long, 100 feet wide, and 5 feet deep at mean low water would cost \$42,000.

An inspection of the chart accompanying the letter of the local officer January 30, 1884, will indicate, I think, that the improvement thereon indicated will benefit the Plymouth Cordage Company only.

The shoal covered by bowlders, which projects 700 feet beyond the high-water line, at a point 1,500 feet east of the wharf of the Plymouth Cordage Company, requires the proposed channel in extension of the Goose Point Channel to be located at a distance of 1,200 feet from the general high-water line of the shore at the nearest point, thereby rendering such an improvement unserviceable to any wharf but that of the Cordage Company.

Even supposing the Goose Point Channel to be extended to the Cordage Company, it would not be expedient or advisable to attempt to reach any wharf to the westward by a new extension, for such a work would but make of the whole channel, from its beginning at Goose Point, to its terminus at the last wharf, an intercepting channel of uncertain maintenance along the whole shore, executed at unreasonable cost, and furnishing but slight advantages over those already afforded by the existing deep-water channel which traverses the bay.

For the foregoing reasons I do not think the extension of the Goose Point Channel "worthy of improvement." The scheme, if executed, will benefit one corporation only at an estimated cost of \$40,000, and if extended to include other wharves and other interests, the estimated cost will not be less than \$75,000, for which the General Government and the local interests would receive no adequate return.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

B 20.

PRELIMINARY EXAMINATION OF WEIR RIVER, MASSACHUSETTS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., October 27, 1888.

GENERAL: In compliance with instructions contained in your circular letter of August 28, 1888, I have the honor to submit this my report of the preliminary examination of Weir River, Massachusetts, provided for in the river and harbor act of August 11, 1888.

Weir River, a southern tributary to Hingham Bay, Boston Harbor, is an inlet rather than a river. At its junction with the neighboring inlet extending to Hingham, the depth is 21 feet, mean low water, and at the head of navigation, near Nantasket Beach, the depth is reduced to 9½

feet, mean low water. The average width of the channel is not less than 250 feet, and the average depth is in excess of 12 feet, mean low water.

This water-way has been previously surveyed and improved under the name of Nantasket Beach Channel (see Annual Report Chief of Engineers, 1887, page 517).

The river and harbor act of June 14, 1880, appropriated \$75,000 for improving harbor at Boston, Mass., of which sum \$5,000 was reserved for application "from said harbor to Nantasket Beach." A survey of the inlet (Weir River) was made July-August, 1880, and a report with chart was submitted to the Chief of Engineers, dated October 28, 1880.

The project contained in the report was for widening and deepening the channel from "World's End" (Coast Survey Boston Harbor, 1887, latitude $42^{\circ} 16' N.$, longitude $70^{\circ} 52' W.$) to Nantasket Beach, and for blasting rocks from the bed, so as to provide a clear channel width throughout 100 feet wide and $9\frac{1}{2}$ feet deep, mean low water. This project was partially completed in 1881.

The river and harbor act of March 3, 1881, appropriated \$5,000 for continuing the improvement, which was applied also in dredging and blasting.

From the appropriation for Boston Harbor, river and harbor act, August 2, 1882, an allotment was made of \$1,750 for completing the blasting of the ledge at the Nantasket Wharf. On the completion of that work the channel had a least width of 200 feet and a least depth of $10\frac{1}{2}$ feet, mean low water, from the mouth of the inlet, opposite Slate Island, to opposite Hampton Hill, and thence to the Nantasket Wharf, a distance of 1,500 feet, approximately. The width was reduced to 100 feet and the depth to $9\frac{1}{2}$ feet, mean low water.

The steamboat companies interested in the navigation of the inlet have found the channel during the past year inadequate to the demands made upon it.

In the first place, it is too narrow opposite World's End (D—E of the chart 1880), and too narrow and too much obstructed by rocky ledges, opposite Planter's Hill (G—F of survey). At this last point, in a deep bend, where the channel depth varies from $9\frac{1}{2}$ feet, mean low water, to 22 feet, mean low water, the south side, near the apex of the curve, is obstructed by a ledge which is marked by a "dolphin." The dolphin is of great service as a guide to the steamers during the heavy fogs which occasionally prevail in summer; the captains want it preserved and the ledge on the south side removed, so that boats in coming out may be able to pass close to the dolphin without risk. The channel at this point should be widened 50 feet on the north side, and for a like width at "D." The ledge at red buoy, opposite bench-mark "K," on Rock Bound Shore, should be examined, and an estimate made for its removal and for the widening of the channel at that point. The channel should be widened likewise opposite "H," Hampton Hill.

These improvements will require, it is estimated, the removal of 10,000 cubic yards of material by dredging and of 150 cubic yards of rocky ledge by blasting, at an estimated cost of \$5,500.

Extensive improvements have taken place on Nantasket Beach and on the shore line to the southward since the report of 1880. The Old Colony Railroad Company has extended its tracks so that there is now an unbroken communication by rail from Hull Landing to Boston, and the many improvements which have been built upon the beach, taken in connection with the increased rail facilities along the shore, have augmented the number of passengers carried annually over the Nantasket

Channel from 500,000 in 1880 to about 1,000,000 in 1888. The tonnage for freight has also increased, though not in the same ratio. After a careful personal examination of the river I am of the opinion that it is "worthy of improvement" in the limited degree desired, and therefore recommend an allotment of \$300 for making a detailed survey of the channel from World's End to the wharf on Nantasket Beach, to enable me to prepare a project with estimates for the proposed improvement.

It is estimated that the cost of the work necessary to give a satisfactory channel will not exceed \$7,000.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

B 21.

PRELIMINARY EXAMINATION OF STAGE HARBOR AT CHATHAM, MASSACHUSETTS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., October 27, 1888.

GENERAL: In compliance with instructions contained in your circular letter of August 28, 1888, I have the honor to submit this my report of the preliminary examination of Stage Harbor, at Chatham, provided for in the river and harbor act of August 11, 1888.

Chatham Roads is the most easterly of the harbors in Nantucket Sound, and lies at the most eastern end of the sound in the bight formed by the southern shore of Cape Cod on the north, Harding's Beach and Morris Island on the east, and Monomy Beach or Island on the south. It has 4 to 6 fathoms low stage and is a good anchorage in northerly and easterly gales, and is much resorted to by coasters and fishermen. If the gale be heavy, vessels drawing less than 8 feet may take refuge in Stage Harbor, which is inclosed by Harding's Beach Point on the west and Morris Island on the east. The entrance to this small but well land-locked harbor is obstructed by two bars, one westward and the other eastward of Harding's Beach Point, over both of which the depth is 4 to 5 feet at mean low water, the range of tides being 4 feet.

The anchorage in Stage Harbor is a semicircular basin, one-half mile long, 500 to 600 feet wide, and 8 to 12 feet deep, mean low water, with good holding ground and good protection against winds for a limited number of vessels.

The harbor having no backwater must rely upon the scour of the tides, impounded in two small tidal basins, for the maintenance of the channel.

Harding's Beach, which shelters the harbor on the west, has on the west, south, and east sides two disconnected reaches of 8 feet depth of water on the line of usual communication between Chatham Roads and Stage Harbor, and the promoters of the survey desire that these reaches be connected and extended so that there may be formed an unbroken water-way, affording 8 feet depth, mean low water, over a convenient width from Chatham Roads to Stage Harbor.

The material is sand, and the margins are largely covered with eel grass. So far as I can learn from a personal examination, the obstruc-

The report is accompanied by two tracings showing the lines recommended.

First.—"Sheet A" delineates the pier and bulkhead lines, separately, from Dover Street Bridge (Fort Point Channel) around the peninsula of Boston to Charles River Bridge, at the mouth of Charles River; the pier and bulkhead lines, coincidently, from Dover Street Bridge (south bank Fort Point Channel) east and south along the South Boston Flats to Slate Ledge; the pier and bulkhead lines, coincidently, along the south shore of the "reserved channel," and around to the south shore of City Point, South Boston, and the pier and bulkhead lines, separately, from Meridian Street Bridge (Chelsea Creek) southward along the western shore of East Boston to Jeffrey's Point.

The pier line is definitely described in Exhibit A. The bulkhead line, where not coincident with the pier line, is parallel to and 600 feet from it inland.

Second.—Sheet B delineates the pier and bulkhead lines, coincidently, from Charles River Bridge along the south shore of Charles River and Charles River Basin to Brookline Street Bridge.

The line is definitely described in Exhibit B.

The foregoing pier lines have been previously established by laws enacted by the Commonwealth of Massachusetts, with the exception of the line projected around City Point, to connect the line established along the south shore of the "reserved channel" with the line established by the State for the southern and eastern shore of South Boston and Dorchester, at the point marked "A" on sheet A.

These lines have been confirmed by us after frequent conferences with the State harbor and land commission, and with all persons interested in the establishment of such lines who presented themselves for conference with the Board.

Preliminary to the location of the lines herein recommended, the Board has prepared (from surveys made for the use of previous commissioners, and from a survey in 1888, made under its own direction), a few supplementary charts to show the present condition of the harbor as compared with that at the date of the earliest survey, in 1835, and particularly its relation to the condition existing in 1861, when the physics of the harbor were elaborately investigated by a Board of United States officers appointed by the General Government at the request of the city government of Boston.

Sheet C is a tracing showing, by squares 200 feet on a side, the changes which had occurred in the bed of the harbor from 1835 to 1861.

Sheet D is a tracing showing corresponding changes from 1861 to 1888.

Sheets C and D are most interesting charts, and if no improvements had been made in the harbor to deepen the natural water-ways by artificial dredging between 1835 and 1888, it might have been possible to trace, during that interval, the changes which have been wrought through the agency of natural forces modified by the artificial encroachments of structures along and projecting from the shore, or by the filling in of interior tidal reservoirs.

But so much desultory dredging has been done by the State and the General Government, at different times since 1860, usually without increase to the tidal prism, and as data are still wanting to enable the Board to analyze causes and effects sufficiently to formulate a satisfactory theory of the action of the forces in operation, the Board considers it best to defer any discussion of the physics of the harbor until the subject can be more thoroughly investigated.

The fact may be noted, however, that during the period from 1835 to 1861 extensive shoaling had taken place in the harbor just above Anchorage Shoal, and that corresponding deepening had taken place along the navy-yard front between the mouths of the Charles and Mystic rivers, as shown on Sheet C, while on Sheet D it appears that between 1861 and 1888 the reverse was the case, the upper area had shoaled and the lower area had deepened.

The Board has not continued its investigations sufficiently to enable it to define the lines it would recommend for the north shore of Charles River Basin, between Brookline Street and West Boston bridges, extending along the Charles River and navy-yard front to the Mystic River.

In this district the original shore-lines have been greatly distorted, and old reservoirs have been reduced in area or wholly obliterated, so that it becomes very important that the lines recommended shall be the best to protect the tidal reservoirs that remain to assist in maintaining the deep-water channels in the harbor below, and to preserve, in a proper way, the avenues which supply these reservoirs.

The Board also makes no recommendation at this time for the lines along South Boston Flats, which extend south of Slate Ledge.

This is an important part of the harbor, lying just outside of the anchorage in front of the city proper, which the Commonwealth of Massachusetts has authorized to be filled in for commercial purposes. The amount of material used for filling equals 4,000,000 cubic yards, approximately, more than one-half of which was dredged from the harbor.

The land thus redeemed from the water is the property of the State, and has been, or will be, sold for its benefit. The reduction of the tidal prism of the harbor caused by this work amounts to 1,000,000 cubic yards, approximately, only a small part of which has been compensated for by excavations above the low-water plane at other places. The whole area of the flats is 500 acres, but only 120 acres have been as yet occupied, though it is alleged that the State intends to fill in eventually all the flats south of the line extending from Slate Ledge to near Castle Island, except the area of a channel 400 feet wide, located on the south side of the flats, and reserved for the benefit of the riparian owners. If the flats are not entirely filled in, they will be at least occupied in such a way as to practically withdraw them from the harbor to the diminution of its tidal prism.

Sheets E, F, and G are transmitted to make the map series complete and to afford means of verifying the results given upon sheets C and D. They are compiled from the surveys of 1835 and 1861, respectively, and the soundings made to conform to the same general plane of reference.

Respectfully submitted.

HENRY L. ABBOT,
Colonel of Engineers,
Bvt. Brig. Gen., U. S. A.
G. L. GILLESPIE,
Lieut. Col. of Engineers.
S. M. MANSFIELD,
Lieut. Col. of Engineers.
W. R. LIVERMORE,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY.
July 24, 1889.

Respectfully submitted to the Secretary of War.

It having been manifest to the Secretary of War that the establishment of harbor lines was essential to the preservation and protection of Boston Harbor, he orally directed the Chief of Engineers to recommend that the subject be referred to a Board of Officers of the Corps of Engineers, to make the necessary examinations and investigations. This recommendation having been made by the Chief of Engineers, it was approved by the Secretary of War August 13, 1888, and a Board of Engineers was constituted to establish harbor lines of Boston Harbor, Massachusetts, under the provisions of the river and harbor act of August 11, 1888.

The Board having submitted the within (first) report and accompanying tracings on which the proposed harbor lines, so far as determined, have been drawn, it is recommended that the lines selected be approved and that the approval of the Secretary be placed upon the tracings submitted.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Second indorsement.]

WAR DEPARTMENT,
July 29, 1889.

Approved.

REDFIELD PROCTOR,
Secretary of War.

APPENDIX C.

IMPROVEMENT OF HARBORS AND RIVERS ON THE SOUTHERN COAST OF MASSACHUSETTS AND IN RHODE ISLAND AND CONNECTICUT.

**REPORT OF MAJOR WILLIAM R. LIVERMORE, CORPS OF ENGINEERS,
OFFICER IN TEMPORARY CHARGE, FOR THE FISCAL YEAR ENDING
JUNE 30, 1889, WITH OTHER DOCUMENTS RELATING TO THE WORKS.**

IMPROVEMENTS.

- | | |
|---|---|
| 1. Harbor of Refuge at Hyannis, Massachusetts. | 10. Removal of Green Jacket Shoal, Providence Harbor, Rhode Island. |
| 2. Harbor of Refuge at Nantucket, Massachusetts. | 11. Newport Harbor, Rhode Island. |
| 3. Vineyard Haven Harbor, Massachusetts. | 12. Harbor of Refuge at Block Island, Rhode Island. |
| 4. Warcham Harbor, Massachusetts. | 13. Pawcatuck River, Rhode Island and Connecticut. |
| 5. New Bedford Harbor, Massachusetts. | 14. Harbor of Refuge at Stonington, Connecticut. |
| 6. Taunton River, Massachusetts. | 15. Removing sunken vessels or craft obstructing or endangering navigation. |
| 7. Warren River, Rhode Island. | |
| 8. Pawtucket River, Rhode Island. | |
| 9. Providence River and Narragansett Bay, Rhode Island. | |

EXAMINATIONS.

- | | |
|--|---|
| 10. Entrance to Point Judith Pond, west of Point Judith, Rhode Island, with a view to establishing a harbor of refuge. | 18. Taunton River, Massachusetts. |
| 17. Westport Harbor, and East and West Branches of Westport River, Massachusetts. | 19. Fishing-Place Cove, near Seaconnet Point, Rhode Island, with view to constructing a breakwater. |
| | 20. Greenwich Bay, to deepen water on the bar at Long Point, Rhode Island. |

ENGINEER OFFICE, U. S. ARMY,
Newport, R. I., July 2, 1889.

GENERAL: I have the honor to submit herewith annual reports for the year ending June 30, 1888, for river and harbor works temporarily in my charge.

This office was assisted during the year by Assistant Engineer Edward Parrish and Assistant Engineer John H. Rostock.

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

C 1.

HARBOR OF REFUGE AT HYANNIS, MASSACHUSETTS.

The harbor of Hyannis lies on the south shore of the peninsula of Cape Cod, about 15 miles to the westward of the heel of the cape, and is an important harbor of refuge.

The mean rise and fall of the tide is about $3\frac{3}{4}$ feet.

ORIGINAL CONDITION.

Before improvement it was an open roadstead, exposed to southerly storms.

PLANS OF IMPROVEMENT.

In the years 1827-1838 a breakwater of riprap granite, 1,170 feet long, was constructed, covering an anchorage of about 175 acres, the entrance to which had a depth of about $15\frac{1}{2}$ feet. In the years 1852-1882 extensive repairs were made in increasing the width of its base and the size of the stone forming its sides and top.

The depth of water immediately inside the breakwater being insufficient for many vessels that seek the harbor of refuge, the present project for the improvement of the harbor published in the Report of the Chief of Engineers for 1885, volume 1, pages 560 and 619-621, contemplates dredging the area protected by the breakwater to a depth of $15\frac{1}{2}$ feet at mean low water.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1888.

The amount expended on this work up to June 30, 1888, was \$127,532.29. The breakwater had been completed according to the original project and the subsequent plans for strengthening it, and the $15\frac{1}{2}$ -foot anchorage area had been increased by about 6.9 acres.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. The contract with the Frank Pidgeon Dredging Company, which was described in the Annual Report of the Chief of Engineers for 1887, expired by limitation June 30, 1888, the contractor having failed to complete the work. The amount covered by this contract therefore became available for further operations. A project for its expenditure, together with the appropriation of \$10,000 made by act of August 11, 1888, was accordingly prepared, and was approved by the Chief of Engineers. The project contemplates beginning the work of dredging at the western edge of the area dredged in 1887, and by cuts running north and south to carry the work to the westward as far as the funds will permit. In accordance with this project advertisements for proposals for dredging were issued December 8, 1888, and the proposals opened January 8, 1889. None of the proposals were made in conformity to the specifications, and the prices bid were excessive. All the proposals were rejected, and the work was readvertised April 2. Proposals under this advertisement were opened April 23, 1889; these were also rejected. Abstracts of the proposals received under both the above advertisements will be found in the appended table.

Arrangements for continuing the work by hire of plant and labor in open market were in progress at the close of the fiscal year.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the completion of the dredging to a depth of $15\frac{1}{2}$ feet in the area limited on the west by a line running due north from the western end of the breakwater and on the north by a line running parallel to the breakwater and distance 1,500 feet from it, leaving a berm of 100 feet along its northern side.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1890.

The execution of the project above referred to, of deepening the anchorage area inside the breakwater, will be continued.

Hyannis Harbor is in the Barnstable collection district, and Barnstable is the nearest port of entry. The amount of revenue collected at Barnstable in the last fiscal year was \$344.62.

The main value of the harbor is for a harbor of refuge. The nearest light-house is Hyannis Light; the nearest fortification is the fort at Clark's Point, New Bedford, Mass.

Money statement.

July 1, 1888, amount available	\$5,825.29
Amount appropriated by act of August 11, 1888.....	10,000.00
	<hr/> 15,825.29
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$1,539.33
July 1, 1889, outstanding liabilities.....	324.19
	<hr/> 1,863.52
July 1, 1889, balance available	13,961.77
	<hr/>
{ Amount (estimated) required for completion of existing projects.....	25,662.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	20,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging at Hyannis Harbor, Mass., received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated December 8, 1888, and opened at 12 o'clock noon, on Tuesday, the 8th day of January, 1889.

[To be commenced on or before May 15, 1889, and to be completed on or before August 15, 1889.]

No.	Name and address of bidder.	Removing bowlders exceeding 1 cubic yard per cubic yard.	Removing other bowlders and dredging per cubic yard. ¹
11	Atlantic Dredging Company, New York, N. Y.	\$35.32	<i>Cents.</i>
12	J. H. Fenner, Jersey City, N. J.		38
13	W. H. Beard, Brooklyn, N. Y.	10.00	35

* Includes \$5,804.47 from lapsed contract.

¹ Measured in scoops.

; Informal.

Abstract of proposals for dredging at Hyannis Harbor, Mass., received at Engineer Office U. S. Army, Newport, R. I., in response to advertisement dated April 2, 1889, and opened at 12 o'clock noon, on Tuesday, the 23d day of April, 1889.

[To be commenced on or before May 15, 1889 and completed on or before July 1, 1890.]

No.	Name and address of bidder.	Removing boulders exceeding 1 cubic yard per cubic yard.	Removing other boulders and dredging per cubic yard.*
1	Atlantic Dredging Company, New York, N. Y.	Cents.	Cents.
12	W. H. Beard, Brooklyn, N. Y.	30	37½

* Measured in place.

† Informal.

COMMERCIAL STATISTICS.

[Furnished by Mr. A. F. Lothrop, Hyannis, Mass.]

Imports.

Coal	tons..	16, 000
Grain	bushels..	100, 000
Lumber	feet..	1, 500, 000
Lime	barrels..	250
Fish	do	1, 000
Merchandise	tons..	100

Exports.

Merchandise, including fish, cedar posts, rails, etc.	tons..	300
--	--------	-----

Vessels in harbor during the year.

Sailing	1, 600
Steam	150

C 2.

HARBOR OF REFUGE AT NANTUCKET, MASSACHUSETTS.

Nantucket Harbor is the only one between the harbors of Martha's Vineyard (Vineyard Haven and Edgartown) and Provincetown, a distance of about 100 miles, except the small harbor of Hyannis, on the other (the north) side of Nantucket Sound. The navigation of this sound is intricate and dangerous by reason of numerous shoals. Nantucket Harbor has deep water inside, and the object of the improvement is to make it a harbor of refuge for vessels plying between ports north and south of Cape Cod, estimated to be 30,000 annually. In the memorial to Congress, on which the first appropriation for this harbor of refuge was based, it was stated that more than 500 vessels had been wrecked in the vicinity of the island.

The mean rise and fall of the tide is about 3 feet.

ORIGINAL CONDITION.

Before the commencement of the present work there was a shoal about 1½ miles in width outside the entrance, through which shoal the channel

or line of best water was only about 6 feet deep and very crooked and subject to changes in location.

PLAN OF THE WORKS.

The present approved project is to construct jetties of riprap stone projecting from either side of the present entrance to the harbor, for the purpose of concentrating the strength of the tidal currents, and excavating a channel of 15 feet depth by scour, and at the places where the full depth required will not be reached by this means to complete the work by dredging. A plan of the works may be found in the Report of the Chief of Engineers for 1885, vol. 1, page 578.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1888.

The amount expended on this project up to the close of the fiscal year ending June 30, 1888, was \$118,458.45, and the result was the construction of the west jetty to a point 3,955 feet from the shore, and the east jetty to a distance of 385 feet from the initial point on the shore, which is the outer end of the middle of the three northwest spurs built on Coatee Beach some years ago, and the foundation was laid and the jetty partially completed for an additional distance of 200 feet.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. The contract with John A. Bouker, which was described in the Annual Report of the Chief of Engineers for 1887, expired by limitation September 1, 1888, the contractor having failed to resume operations at the beginning of the working season of that year. The amount covered by his contract accordingly became available for further operations. A project for its expenditure, together with the appropriation of \$20,000 made by act of August 11, 1888, approved by the Chief of Engineers, contemplates the extension of the eastern jetty as far as the funds will permit. In accordance with this project advertisements for proposals for furnishing riprap granite were issued December 17, 1888, and the proposals opened January 17, 1889. An abstract of the proposals received and the terms of the contract will be found in the appended table.

Work under this contract was commenced May 15, 1889, and was in progress at the close of the fiscal year. The amount of stone placed in the eastern jetty under the contract was 673 tons.

Until the two jetties are completed and a light-house erected on one of them the end of the west jetty will be a source of danger to vessels entering and leaving the port at night. In order to avoid this danger as far as possible a temporary light has been established at the end of that jetty, which has been faithfully maintained during the year.

Mr. C. O. Abell is local inspector of the work of the construction of the east jetty.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the completion of the east and west jetties, and the excavation by dredging of so much of the channel as may not be excavated by tidal scour,

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1890.

It is proposed to continue the construction of the east jetty as far as the available funds will permit.

Nantucket is in the Nantucket collection district, and is a port of entry. The amount of revenue collected at Nantucket in the last fiscal year is not known. The value of the harbor is mainly as a harbor of refuge. The nearest light-houses are Nantucket Cliff and Brant Point lights. The nearest fortification is the fort at Clark's Point, New Bedford, Mass.

Money statement.

July 1, 1888, amount available	*\$6,541.55
Amount appropriated by act of August 11, 1888.....	20,000.00
	<u>26,541.55</u>
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$2,772.32
July 1, 1889, outstanding liabilities.....	1,788.20
July 1, 1889, amount covered by existing contracts	18,784.80
	<u>23,345.32</u>
July 1, 1889, balance available	<u>3,196.23</u>
{ Amount (estimated) required for completion of existing project.....	230,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	50,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for furnishing and placing riprap granite in the eastern jetty at Nantucket, Mass., received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated December 17, 1888, and opened at 12 o'clock noon, on Thursday, the 17th day of January, 1889.

[Work to be commenced on or before May 15, 1889, and completed on or before August 15, 1889.]

No.	Name and address of bidder.	Price per ton of 2,000 pounds.
1	James Scully, Groton, Conn.....	\$2.40
2	Francis H. Smith, New York, N. Y.....	2.47
3	James V. Luce, Nantick, Conn.....	2.40
4	William H. Molthrop & Co., New London, Conn.....	2.40
5	Charles H. Edwards, Quincy, Mass.....	2.34

Contract awarded to James Scully, of Groton, Conn., with the approval of the Chief of Engineers, and dated February 8, 1889.

COMMERCIAL STATISTICS.

Furnished by Mr. Joseph W. Clapp, collector of customs, Nantucket, Mass.]

Imports.

Coal.....	tons..	9,250
Grain.....	bushels..	4,000
Flour.....	barrels..	4,800
Hay.....	tons..	230

* From lapsed contract.

Lumber	feet..	1, 500, 000
Brick		200, 000
Lime	barrels..	800
Cement	do.....	350
Wood	cords..	280
Salt	bushels..	600
Railroad sleepers.....	pieces..	2, 400
General merchandise.....	tons..	4, 000

Vessels in harbor during year.

Sailing	213
Steam	17

C 3.

IMPROVEMENT OF VINEYARD HAVEN HARBOR, MASSACHUSETTS.

Vineyard Haven is a deep indentation in the northern shore of the island of Martha's Vineyard, on the southern side of Vineyard Sound. It is triangular in form and faces the northeast. The width of the mouth of the harbor, or the distance between the points of land on the east and west sides of the entrance known as East Chop and West Chop, is about $1\frac{1}{2}$ miles, and from a line connecting the chops to the narrow southerly end of the harbor, at which is situated the town of Vineyard Haven, the distance is about $1\frac{3}{4}$ miles. The entire area of the harbor between the shore-lines is about 949 acres, of which some 657 acres have a depth of not less than 15 feet. The mean rise and fall of the tide is 1.7 feet.

At the mouth of the harbor the wearing away of the chops by the action of the waves in storms has been noted for many years. The former site of a light-house on West Chop has entirely disappeared. The débris is carried by the current into the harbor, where it forms shoals which are gradually impairing the anchorage capacity, especially in the upper part of the harbor.

This is a new work and no appropriation had been made for it until, by act of August 11, 1888, Congress appropriated \$25,000 for the protection of the chops.

PLAN OF IMPROVEMENT.

As preliminary to the preparation of a general plan for the protection of the chops, it is proposed to devote a portion of the appropriation to the construction of a series of experimental jetties and other works. These constructions will serve as an immediate protection to the bluffs, and at the same time will furnish a basis for determining the character and extent of the permanent works required.

OPERATIONS DURING THE LAST FISCAL YEAR.

During the last fiscal year a survey of the vicinity of the chops was made, and the construction of a temporary wharf for landing material, and of the experimental jetties, was commenced.

Mr. W. O. Simmons is local superintendent of the work.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE
30, 1890.

The work will be prosecuted according to the approved project.

Vineyard Haven is in the Edgartown collection district. Edgartown is the nearest port of entry. The amount of revenue collected at Edgartown in the last fiscal year was \$408.34. The nearest light-houses are those on East and West Chops. The nearest fortification is fort at Clark's Point, New Bedford, Mass.

Money statement.

Amount appropriated by act of August 11, 1888	\$25,000.00
July 1, 1889, amount expended during fiscal year, exclusive of	
liabilities outstanding July 1, 1888.....	\$2,737.73
July 1, 1889, outstanding liabilities.....	1,184.99
	<hr/>
	3,922.72
July 1, 1889, balance available	<hr/>
	21,077.28
	<hr/>
{ Amount (estimated) required for completion of existing project.....	35,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	35,000.00
{ Submitted in compliance with requirements of sections 2 of river and	
harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

[Furnished by Mr. E. C. Lord, Vineyard Haven, Mass.]

Receipts.

Coal.....	tons..	6,500
Grain.....	bushe s..	4,000
Lumber.....	feet..	1,000,000

Besides the above, 4,500 tons of general merchandise were landed here by the regular steamer lines.

The number of vessels which discharged cargoes at Vineyard Haven Harbor, year ending June 1, 1889, was 23.

C 4.

IMPROVEMENT OF WAREHAM HARBOR, MASSACHUSETTS.

This harbor is an estuary at the head of Buzzard's Bay. The object of the improvement is to deepen and widen the channel leading from Buzzard's Bay to Wareham, the industries of which, and of several towns in the vicinity with which it is connected by rail, are chiefly the manufactures of iron, and depend largely on transportation by water of the material used therein. The commerce of Wareham is carried on in sailing vessels, and the channel is to be made a beating channel for such vessels.

Another object of the improvement is the raising of Long Beach, over which the sands from the bay were washed into the harbor. The mean rise and fall of the tide is 4 feet.

ORIGINAL CONDITION.

Before improvement the ruling depth in the harbor was about 7 feet at mean low water, in a narrow and very crooked channel. Long Beach, a narrow sand spit at the mouth of the harbor, was washed and abraded by the waves and currents at high water, and the material was carried into and shoaled the channel inside.

PLANS OF IMPROVEMENT.

The original approved project of 1871, for the improvement, and its subsequent modifications, provide for a channel 250 feet wide and 10 feet deep at mean low water from Barney's Point down to the entrance to the harbor. Above Barney's Point the width of the channel is to be 350 feet, with the same depth, 10 feet, as below that point. The plan includes, also, the raising and strengthening of Long Beach, of which a large portion was submerged at low water, to carry it above the storm waves and currents and to hold it there in order to prevent the filling of the improved channel above by material abraded from the beach.

A plat of Wareham Harbor, showing the lines of the channel now being excavated, may be found in the Annual Report of the Chief of Engineers for 1885, vol. 1, page 586.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1888.

The total amount expended on the improvement up to the close of the fiscal year ending June 30, 1888, including liabilities outstanding at that date, was \$71,520.64, and the result was that the channel in the upper part of the harbor in front of the wharves was carried to its full width and completed, and the eastern half of the second and third reaches below the wharves and about two-thirds of the eastern half of the fourth reach, which extends to Barney's Point, were excavated to the full depth of 10 feet below mean low water. Long Beach had been raised above high-water storm tides, so that the wash of sand into the improved channel inside the beach had been stopped.

The channel for about one-half its width from Barney's Point to Wareham had been deepened to 10 feet, and a ruling depth of the approaches to Wareham had been increased from 7 to 9 feet, and the channel greatly widened in all the reaches.

Vessels of larger draught can be carried to Wareham than formerly. The increase in width of channel was a great help to all vessels in beating in and out of the harbor.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. The contract with the Frank Pidgeon Dredging Company which was described in the Annual Report of the Chief of Engineers for 1887, expired by limitation June 15, 1888, the contractor having failed to complete the work. The amount covered by this contract accordingly became available for further operations. A project for the expenditure of this sum, together with the appropriation of \$4,000 made by act of August 11, 1888, was prepared and was approved by the Chief of Engineers. This project contemplates, first, the completion of the eastern part of the channel to a width of 175 feet from the end of the present dredged channel to the deep water of Long Beach, and the further building up of Long Beach (which requires the expenditure of a few hundred dollars); and, second, if funds remain, widening the upper reaches of the channel to 250 feet, and the formation of an anchorage basin by dredging one or more of these reaches to its full width of 350 feet.

In accordance with this project advertisements for proposals for dredging were issued December 8, 1888, and proposals opened January 8, 1889. None of the proposals were made in conformity to the specifications, and the prices bid were excessive. All the proposals were rejected, and the work was re-advertised April 2, 1889. Under this advertisement one proposal was received. It was opened April 23, 1889,

and was rejected as excessive. Abstracts of proposals received under both the above advertisements will be found in the appended tables.

Arrangements for continuing the work by hire of labor and purchase or hire of plant in open market were in progress at the close of the fiscal year.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the excavation of the channel to its full width and depth down to the deep water above Long Beach, and the further building up of Long Beach by the construction of sand fences.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1890.

It is proposed to devote the funds on hand July 1, 1889, to the completion of the eastern part of the channel to a width of 175 feet from the end of the present dredged channel to the deep water of Long Beach, and widening one or more of the upper reaches of the river, and to the further building up of Long Beach.

Wareham is in the New Bedford collection district. New Bedford is the nearest port of entry. The amount of revenue collected at New Bedford in the last fiscal year was \$90,239.63. The nearest light-houses are Bird's Island and Wing's Neck lights. The nearest fortification is the fort at Clark's Point, New Bedford, Mass.

Money statement.

July 1, 1888, amount available		\$8,479.46
Amount appropriated by act of August 11, 1888		4,000.00
		<hr/> 12,479.46
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$1,248.22	
July 1, 1889, outstanding liabilities	278.34	
		<hr/> 1,526.56
July 1, 1889, balance available		10,952.90
{ Amount (estimated) required for completion of existing project		12,236.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891		12,236.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for dredging at Wareham Harbor, Mass., received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated December 8, 1888, and opened at 12 o'clock noon, on Tuesday, the 8th day of January, 1889.

[To be commenced on or before March 15, 1889, and completed on or before August 15, 1889.]

No.	Name and address of bidder.	Removing bowlders exceeding 1 cubic yard, per cubic yard.	Removing other bowlders and dredging, per cubic yard.†
			Cents.
1	Atlantic Dredging Company, New York, N. Y	\$35.26	28
2	J. H. Fenner, Jersey City, N. J.		29
3	W. H. Beard, Brooklyn, N. Y	10.00	

* From lapsed contract.

† Measured in scoops.

‡ Informal.

Abstract of proposals for dredging at Wareham Harbor, Mass., received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated April 2, 1889, and opened at 12 o'clock noon, on Tuesday, the 23d day of April, 1889.

[Work to be commenced on or before May 15, 1889, and completed on or before July 1, 1890.]

No.	Name and address of bidder.	Removing bowlders exceeding 1 cubic yard, per cubic yard.	Removing other bowlders and dredging, per cubic yard.*
1	Hartford Dredging Company, Hartford, Conn.....	\$10	Cents. 55

* Measured in place.

C 5.

IMPROVEMENT OF NEW BEDFORD HARBOR, MASSACHUSETTS.

New Bedford Harbor is an estuary of Buzzard's Bay, and is the port of the cities of New Bedford and Fairhaven, Mass. New Bedford is an important port of entry. It is largely interested in manufactures, those of cotton predominating, and has an extensive commerce in addition to its whale fisheries. The population of New Bedford and Fairhaven in 1888 was about 38,000.

The object of the improvement is to provide a channel 18 feet deep at mean low water.

The mean rise and fall of the tide is about 3 feet.

ORIGINAL CONDITION.

Before improvement, the channel had a ruling depth of about 12½ feet at mean low water.

PLANS OF IMPROVEMENT.

As early as 1839 some little dredging was done for the improvement of the harbor. The increase of depth obtained, however, was only 2 feet, and the cut but 30 feet wide. A survey of the harbor was made in 1852, but a definite project for its improvement was not made until 1874. The project provided for a channel 200 feet wide and 15 feet deep at mean low water from the deep water just above Palmer's Island to the wharves at New Bedford. This project was modified in 1877, increasing the width of channel to 300 feet, and by means of appropriations made in 1875-'76, amounting to \$20,000, the project was completed in 1877. Since that time vessels of larger draught have been employed in the harbor, and vessels of 15 feet draught not only now touch the bottom in this channel, but in the channel below Palmer's Island, which was not included in the former improvement. There is not sufficient water for the commerce of the port.

The project under which work is now carried on was adopted in 1888. It provides for the excavation of a channel 200 feet wide and 18 feet deep at mean low water extending from Butler's Flat to the vicinity of

the wharves at New Bedford. A plat of the proposed improvement was published in House Ex. Doc. No. 86, Fiftieth Congress, first session.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1888.

The amount expended to June 30, 1888, was \$20,000. The result was the excavation of the channel, under the original project and its modification, to a width of 300 feet, and a depth of 15 feet at mean low water.

OPERATIONS DURING THE LAST FISCAL YEAR.

By act of August 11, 1888, Congress appropriated \$10,000 for continuing the improvement, and a project for the expenditure of this sum was prepared and was approved by the Chief of Engineers. The project contemplates the commencement of the work near the lower end of Palmer's Island, at a point known as the "11-foot bank," and dredging to a depth of 18 feet at mean low water, and a width of 100 feet, along the westerly and southerly sides of the proposed channel, carrying it as far towards the wharves of the city as the available funds will permit.

Advertisements for proposals for dredging were issued December 8, 1888, and the proposals opened January 8, 1889. None of the proposals were made in accordance with the specifications and the prices bid were excessive. All of the proposals were rejected and the work was re-advertised April 2. Proposals under this advertisement were opened April 23, 1889. These were also rejected. Abstracts of proposals received under both the above advertisements will be found in the appended tables.

Arrangements for continuing the work by hire of labor and purchase or hire of plant in open market were in progress at the close of the fiscal year.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1890.

The balance available and the appropriation asked will be applied to the continuation of the work under the approved project.

New Bedford Harbor is in the New Bedford collection district, which is a port of entry. The amount of revenue collected in the last fiscal year was \$90,239.63. The nearest light-houses are Clark's Point Light and the lights in New Bedford Harbor. The nearest fortification is the fort at Clark's Point, Mass.

Money statement.

Amount appropriated by act of August 11, 1888.....	\$10,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$814.33
July 1, 1889, outstanding liabilities.....	176.67
	<hr/>
	991.00
July 1, 1889, balance available.....	<hr/>
	9,009.00
	<hr/>
{ Amount (estimated) required for completion of existing project.....	25,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	20,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging at New Bedford Harbor, Mass., received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated December 8, 1889, and opened at 12 o'clock noon, on Tuesday, the 8th day of January, 1890.

[To be commenced on or before March 15, 1890, and completed on or before August 15, 1890.]

No.	Name and address of bidder.	Removing bowlders exceeding 1 cubic yard, per cubic yard.	Removing other bowlders and dredging, per cubic yard.*
† 1	Atlantic Dredging Company, New York, N. Y	\$35. 24	Cents.
† 2	J. H. Fenner, Jersey City, N. J		24
† 3	W. H. Beard, Brooklyn, N. Y		30

* Measured in scoops.

† Informal.

Abstract of proposals for dredging at New Bedford Harbor, Mass., received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated April 2, 1889, and opened at 12 o'clock noon, on Tuesday, the 23d day of April, 1889.

[To be commenced on or before May 15, 1889, and completed on or before January 1, 1890.]

No.	Name and address of bidder.	Removing bowlders exceeding 1 cubic yard, per cubic yard.	Removing other bowlders and dredging, per cubic yard.*
1	Hartford Dredging Company, Hartford, Conn.	\$10. 00	Cents. 35
2	Atlantic Dredging Company, New York, N. Y		36
† 3	W. H. Beard, Brooklyn, N. Y .....	. 40	

* Measured in place.

† Informal.

COMMERCIAL STATISTICS.

[Furnished by Mr. Weston Howland, collector of customs.]

Receipts at New Bedford and Fairhaven, Mass., for the year ending December 31, 1888.

Lumber	feet..	14,992,530
Coal	tons..	365,766
Corn and oats	bushels..	83,276
Cotton	bales..	14,454
Linne	barrels..	12,086
Flour	do	10,779
Cement	do	8,575
Sugar	do	7,866
Manilla	bales..	5,941
Iron	tons..	8,338
Sisal	bales..	4,440
Meal	bushels..	2,933
Tar	barrels..	1,534
Hemp	bales..	1,711
Molding-sand	tons..	888
Paving-blocks	do	1,088

The number of arrivals at this port for the year ending December 31, 1888, is 1,772, viz:

Steamers	708	Ships	1
Barks	13	Brigs	2
Schooners	809	Sloops	29
Barges	210		

The tonnage of the above is 574,512 tons.

C. 6.

IMPROVEMENT OF TAUNTON RIVER, MASSACHUSETTS.

This river rises in Norfolk County, Mass., and empties into Mount Hope Bay, a name given to the northeastern part of Narragansett Bay. It is about 44 miles in length, measured along its course.

The object of the improvement is to deepen and widen the channel leading to the city of Taunton, at the head of navigation, which requires large quantities of coal, iron, clay, moldings, sand, and other heavy articles for its extensive manufactures dependent largely on water transportation, so that vessels of 11 feet draught can reach the city at high water. The rise and fall of the tide before improvement was $5\frac{1}{2}$ feet at Dighton and 3.4 feet at Taunton.

ORIGINAL CONDITION.

In its original condition the channel was narrow and obstructed by bowlders, and from Berkley Bridge to Taunton the depth was not, in places, more than 5 feet at mean high water. A vessel of 30 tons burden was as large as could go up to Taunton.

PLANS OF IMPROVEMENT.

The approved project of 1871, and its subsequent modifications, provides for a channel 60 feet wide and 11 feet deep from Weir Bridge to the ship-yard; a channel 80 feet wide (100 feet at the bends) and 11 feet deep from the ship-yard down to and through the Needles and Brigg's Shoal; thence to Berkley Bridge a channel of the same width and 12 feet deep. From Berkley Bridge to the deep water at Dighton the channel was to be 100 feet wide and 12 feet deep. The depths are estimated from high waters. The ledge which crossed the bottom of the river at Peter's Point and the numerous bowlders which lay on the bottom and sides of the channel from Taunton to Dighton were to be removed.

A plat of the river showing the improved channel was published in the Annual Report of the Chief of Engineers for 1884, page 606.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1888.

The amount expended on the improvement of the river up to the close of the fiscal year ending June 30, 1888, including liabilities outstanding at that date, was \$156,935.94.

With the exception that but 40 feet of the 60 feet of width could be dredged between the bridge at Weir and the ship-yard on account of interfering with private property, and that on account of the hardness and depth of material at the sides the 80-foot channel was not in all cases dredged to its full width, the channel down to Berkley Bridge had been completed. The channel as proposed between Berkley Bridge and Dighton had been completed, with the exception of removing a small amount of ledge rock uncovered in dredging, and had been cleared of bowlders from Taunton down to Berkley Bridge. The work of removal of the ledge at Peter's Point had been completed. The material blasted in the channel had been dredged and deposited in the form of a half tide dam running from Reuben's Island to the west shore of the river, with the view of accelerating the current in the dredged channel

off and above Dighton and preventing deposits in that part of the channel. Vessels of 11 feet draught can now reach Taunton at the head of navigation.

OPERATIONS DURING THE LAST FISCAL YEAR.

No work was done during the last fiscal year.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

There remains to complete the existing project the widening and deepening of the channel at a few points above the bridge and the removal of the small amount of ledge rock above referred to. This ledge projects about 30 feet into the eastern side of the channel, diminishing its depth by a few inches, while there is ample width and depth beyond the channel line on the western side.

In compliance with the provisions of the river and harbor act of August 5, 1886, a survey of portions of Taunton River was made in October, 1887, and the map and report thereon were submitted to the Chief of Engineers November 21, 1887, and were printed in House Ex. Doc. No. 86, Fiftieth Congress, first session. The estimated cost of this additional improvement is \$14,051.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1890.

It is proposed to complete the existing project for the improvement of the river if funds are appropriated therefor.

Taunton River is in the Fall River collection district. Fall River is the nearest port of entry. The amount of revenue collected at Fall River in the last fiscal year was \$107,356.74. The nearest light-house is the Borden Flat light-house. The nearest fortification is Fort Adams, Newport Harbor, Rhode Island.

Money statement.

July 1, 1888, amount available.....	\$64.06
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	31.78
July 1, 1889, balance available.....	32.28
<hr/>	
{ Amount (estimated) required for completion of existing project.....	14,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	14,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

[Furnished by Mr. H. A. Dean, Taunton, Mass.]

Receipts at Taunton by water, 1888.

Lumber.....	feet..	12,500,000
Grain.....	bushels..	1,325,800
Flour.....	barrels..	45,000
Coal.....	tons..	265,000
All other merchandise.....	do..	30,000
Metals of all kinds.....	do..	33,000
Cotton.....	bales..	27,000
Molding sand.....	tons..	24,000
Clay.....	do..	30,000

Number of vessels employed on Taunton River, 59; viz, 46 sailing-vessels, 9 barges, 4 tugs; of an average draught of 10 feet and tonnage of 500 tons.

C 7.

IMPROVEMENT OF WARREN RIVER, RHODE ISLAND.

Warren River is an arm of Narragansett Bay, north of the harbor of Bristol. The obstructions to navigation were a rocky reef below Little Island, and a submerged boulder, known as Bushworth Rock, near mid-channel, opposite the lower wharf of the town of Warren. By act approved August 5, 1886, Congress appropriated \$5,000 for the improvement of the river, and with this sum it was proposed that the boulder and reef referred to be removed as far as possible.

PLANS OF IMPROVEMENT.

The work of improvement was one that could not be well carried on by contract, and the approved project was first to remove Bushworth Rock, and afterwards to remove the boulders which lay submerged on the western side of the narrowest portion of the channel at Little Island, and also the projecting portions of the ledge beneath the boulders, widening the channel as much as the funds available permitted; it also included the hiring in open market of a vessel with working crew, submarine diver, firing battery, and steam hoisting apparatus, and purchase of the explosives also in open market.

A plat of the river, showing the proposed improvement near Little Island, was published in the Annual Report of the Chief of Engineers for 1885, page 630.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1888.

The amount expended to June 30, 1888, including liabilities outstanding at that date, was \$4,699.39. The result was the removal of Bushworth Rock to the depth of the surrounding water, and the removal of the boulders and points of ledge rock over an area of about 1.8 acres in the vicinity of Little Island, extending 550 feet along the narrowest part of the channel. This work finished the improvement as far as projected.

OPERATIONS DURING THE LAST FISCAL YEAR.

No work was done during the last fiscal year.

Warren River is in the Bristol-Warren collection district, which is a port of entry. The amount of revenue collected in the last fiscal year is unknown. The nearest light-house is the light-house on Conimicut Point, Providence River. The nearest fortifications are fort on Dutch Island and Fort Adams, Rhode Island.

Money statement.

July 1, 1888, amount available	\$270. 11
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$128. 30
July 1, 1889, outstanding liabilities.....	22. 03
	<hr/>
	150. 33
July 1, 1889, balance available.....	119. 78

C 8.

IMPROVEMENT OF PAWTUCKET RIVER, RHODE ISLAND.

The navigable part of the Pawtucket (or Seekonk) River, an arm of Providence River, extends from Providence to Pawtucket, a city which in 1885 had a population of about 23,000, and extensive manufactures, depending largely on water transportation. The object of the improvement is to widen and deepen the channel leading to Pawtucket, so that vessels of 12 feet draught can reach that city at mean low water. The mean rise and fall of the tide is about 5 feet.

ORIGINAL CONDITION.

Before improvement the channel in the river had a ruling depth of about 5 feet at mean low water.

PLANS OF IMPROVEMENT.

The original project, as modified in 1883, provides for the excavation by dredging of a channel 100 feet wide and 12 feet deep at mean low water from the deep water above Red Bridge to the ledge opposite Grant & Co.'s Wharf at Pawtucket; thence the deepening by blasting of the channel through the ledge to Pawtucket Bridge to the same depth, and 40 feet wide.

A plat of the river showing the lines of the proposed channel was published in the Annual Report of the Chief of Engineers for 1884, page 608.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1888.

The amount expended to June 30, 1888, was \$131,129.99. The channel had been excavated under the original project to a width of 75 feet and a ruling depth of 7 feet at mean low water, and under the project as modified in 1883 a new channel 12 feet deep and 100 feet wide, with wide enlargements at the bends, had been carried from its mouth at the deep water just above Red Bridge, a distance of about 12,740 feet. There is now a channel 100 feet wide and 12 feet deep at mean low water from the deep water above Red Bridge to Bass Rock, or to within about $\frac{1}{4}$ miles of the head of navigation.

This completed portion of the channel is already a great benefit to the commerce of the river. A ruling depth of about 6 feet can be carried from the upper end of our present work to Pawtucket.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. By act of August 11, 1888, Congress appropriated \$35,000 for continuing the improvement. A project for expenditure of this sum was accordingly prepared and was approved by the Chief of Engineers. This project contemplated the continuation of the enlarged channel as far towards Pawtucket as the funds would allow, affording at the same time such relief as commerce should require at the shoalest place above the main work; and the commencement of the work on the ledge which lies in the channel off Pawtucket if funds should permit.

Advertisements for proposals for dredging under this project were published December 8, 1888, and proposals opened January 8, 1889. None of the proposals were made in accordance with the specifications, and the prices bid were excessive. All the proposals were rejected, and the work was readvertised April 2, 1889. Proposals under this advertisement were opened April 23, 1889, and were also rejected. Abstracts of proposals received under both the above advertisements will be found in the appended tables.

Arrangements for continuing the work by hire of plant and labor in open market were in progress at the close of the fiscal year.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work yet to be done is to excavate, by dredging, the channel 12 feet deep and 100 feet wide, from Bass Rock to a point opposite Grant & Co.'s Wharf, and thence to Pawtucket Bridge, to deepen the channel through the ledge to the same depth with a width of 40 feet.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1890.

It is proposed to extend the channel towards Pawtucket.

Pawtucket is in the collection district of Providence, and that port is the nearest port of entry. The amount of revenue collected at Providence in the last fiscal year was \$260,813.27. The nearest light-house is Sassafras Point Light. The nearest fortifications are Fort Adams, Newport, R. I., and the fort on Dutch Island, Rhode Island.

* Money statement.

July 1, 1888, amount available	\$375. 97
Amount appropriated by act of August 11, 1888	35, 000 00
	<hr/> 35, 375. 97
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$3, 204. 13
July 1, 1889, outstanding liabilities	171. 71
	<hr/> 3, 375. 84
July 1, 1889, balance available	32, 500. 13
	<hr/>
{ Amount (estimated) required for completion of existing project	367, 474. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	50, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in Pawtucket River, Rhode Island, received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated December 8, 1888, and opened at 12 o'clock noon on Tuesday, the 8th day of January, 1889.

[To be commenced on or before March 15, 1889, and completed on or before August 15, 1890.]

No.	Name and address of bidder.	Removing bowlders exceeding 1 cubic yard, per cubic yard.	Removing other bowlders and dredging, per cubic yard.
†1	Brainard Bros., New York, N. Y	\$5. 95	Cents. 12½
†2	W. H. Beard, Brooklyn, N. Y	10. 00	27

* Measured in scows.

† Informal.

Abstract of proposals for dredging in Pawtucket River, Rhode Island, received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated April 2, 1889, and opened at 12 o'clock noon on Tuesday, the 23d day of April, 1889.

[To be commenced on or before May 15, 1889, and completed on or before January 1, 1890.]

No.	Name and address of bidder.	Removing bowlders exceeding 1 cubic yard, per cubic yard.	Removing other bowlders and dredging, per cubic yard.*
1	Brainard Bros., New York, N. Y	\$15. 00	Cents. 35
†2	W. H. Beard, Brooklyn, N. Y	87	.....

* Measured in place.

† Informal.

COMMERCIAL STATISTICS.

[Furnished by Business Men's Association, Pawtucket, R. I., 1888.]

Receipts.

Coal	tons..	150,000
Cement	barrels..	9,657
Lime	do...	5,628
Long lumber (about)	feet..	5,000,000
Short lumber	do...	1,000,000
Spool wood	do...	270,000

together with large quantities of brick, iron, gravel, cotton, and various kinds of other merchandise which are used by this community.

There passed through the draw of the Washington Bridge, Pawtucket River, during the year 1887:

Steamers	684	Tow-boats	2,356
Schooners	334	Sail-boats	486
Barges	492	Miscellaneous	1,470

C 9.

IMPROVEMENT OF PROVIDENCE RIVER AND NARRAGANSETT BAY, RHODE ISLAND.

Providence River is an estuary of Narragansett Bay. The object of its improvement is to furnish a wide and deep channel for European and coastwise commerce from the ocean to Providence, a city which had in 1885 about 125,000 inhabitants, largely engaged in manufactures, and a port of entry for an extensive region of country, with which it is connected by railroads. The mean rise and fall of the tide is 4.7 feet.

ORIGINAL CONDITION.

Before the improvement of the river was commenced, in 1853, many shoals obstructed navigation, and at one point in the channel, a place called "The Crook," the available low-water depth was but 4½ feet.

PLANS OF IMPROVEMENT.

There was expended between 1852 and the 30th of June, 1882, \$290,459.34 in deepening the channel; first to 9 feet, then to 12 feet; then to 14 feet, and again to 23 feet, as the increasing sizes of vessels

and the growing commerce of Providence demanded. Bulkhead Rock was also removed during this period to a depth of 20 feet below mean low water.

The approved project of 1878, modified in 1882, under which we are now working, provides for a channel 25 feet deep and 300 feet wide, suitable for large ocean vessels, extending from Fox Point, in the city of Providence, to the deep water of Narragansett Bay, and for an anchorage basin between Fox and Field's points of the following dimensions in cross-section, viz:

300 feet wide, 25 feet deep.
600 feet wide, 20 feet deep.
725 feet wide, 18 feet deep.
940 feet wide, 12 feet deep.
1,060 feet wide, 6 feet deep.

The 25-foot channel has been laid out in straight reaches (with enlargements at the angles), with a view to lighting them by range or leading lights, such as are used in similar cases in Chesapeake Bay, Delaware River, and other localities, if it should be found necessary.

A plat of Providence River, showing the improved channel, was published in the Annual Report of the Chief of Engineers for 1884, page 622.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1888.

The amount expended on the present project up to the close of the fiscal year ending June 30, 1888, including liabilities outstanding at that date, was \$242,599.60. At that date the excavation of the 20-foot anchorage area in the Fox Point Reach had been completed, and of the same areas in the Sassafras Point and the Field's Point reaches about one-fourth and one-half, respectively, had been done. Bulkhead Rock had been removed, and the 25-foot channel, 300 feet wide, from Providence to the deep water of Narragansett Bay had been completed.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. By act of August 11, 1888, Congress appropriated \$40,000 for continuing the improvement. A project for expending this sum was accordingly prepared and was approved by the Chief of Engineers. The project contemplates, first, the completion of that part of the anchorage basin above Field's Point, which is to be deepened to 20 feet; second, to excavate that part of it to be deepened to 18 feet; and third, if funds remain, to begin the excavation of that part to be deepened to 12 feet.

Advertisements for proposals for dredging under this project were published December 8, 1888, and proposals opened January 8, 1889. None of the proposals were made in accordance with the specifications, and the prices bid were excessive. All the proposals were rejected and the work was re-advertised April 2, 1889. Proposals under this advertisement were opened April 23, 1889, and were also rejected. Abstracts of proposals received under both the above advertisements will be found in the appended tables.

Arrangements for continuing the work by hire of plant and labor in open market were in progress at the close of the fiscal year.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

There is required for the completion of the existing project the remainder of the excavation of the anchorage basin between Fox and Field's points.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1890.

It is proposed to continue the excavation of the anchorage area.

Providence River is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence in the last fiscal year was \$260,813.27. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are fort on Dutch Island and Fort Adams, R. I.

Money statement.

July 1, 1888, amount available	\$1,001.03
Amount appropriated by act of August 11, 1888	40,000.00
	<hr/> 41,001.03
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$4,235.35
July 1, 1889, outstanding liabilities	48.41
	<hr/> 4,283.76
July 1, 1889, balance available	<hr/> 36,717.27
<hr/>	
{ Amount (estimated) required for completion of existing project	165,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	100,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in Providence River, Rhode Island, received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated December 8, 1888, and opened at 12 o'clock noon, on Tuesday, the 8th day of January, 1889.

[To be commenced on or before March 15, 1889, and completed on or before August 15, 1889.]

No.	Name and address of bidder.	Removing bowlders exceeding 1 cubic yard, per cubic yard.	Removing other bowlders and dredging, per cubic yard.*
†1	Atlantic Dredging Company, New York, N. Y	\$25.12	Cents.
†2	W. H. Beard, Brooklyn, N. Y		14
†3	Brainard Bros., New York, N. Y		15½

* Measured in scows.

† Informal.

Abstract of proposals for dredging in Providence River, Rhode Island, received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated April 2, 1889, and opened at 12 o'clock noon, on Tuesday, the 23d day of April, 1889.

[To be commenced on or before May 15, 1889, and completed on or before July 1, 1890.]

No.	Name and address of bidder.	Removing bowlders exceeding 1 cubic yard, per cubic yard.	Removing other bowlders and dredging, per cubic yard.*
†1	Atlantic Dredging Company, New York, N. Y	Cents.	Cents.
†2	W. H. Beard, Brooklyn, N. Y	21	19½

* Measured in place.

† Informal.

COMMERCIAL STATISTICS.

[Furnished by Providence Board of Trade.]

Receipts.

Articles.	Quantity	Articles.	Quantity.
Laths.....	8,752,500	Shingles.....	6,128,739
Salt.....pounds..	8,792,185	Pickets.....	50,833
Brimstone.....tons..	1,256	Wood.....cords..	2,674
Starch.....casks..	149	Logwood.....tons..	4,397
Cotton.....bales..	203,726	Potatoes.....bushels	6,673
Wool.....bales..	84,156	Beef.....tons..	11,639
Wool.....sacks..	45,496	Flour.....barrels	254,564
Coal.....tons..	1,061,227	Corn.....bushels	1,676,186
Iron and steel.....tons..	43,942	Oats.....bushels	1,373,000
Lumber.....feet..	64,329,000	Dry goods.....cases..	70,450
Oil.....barrels..	163,622	Chemicals.....packages	114,545
Waste.....tons..	6,425	Liquor.....barrels	8,564
Print cloths.....bales..	35,400	Meal.....bushels	38,580
Lime.....barrels..	525	Bran.....bushels	227,672
Sawwoods.....tons..	6,163	Coffee.....pounds..	4,970
Scrap iron.....tons..	15		

Tonnage.

Vessels.	No.	Tonnage.
Sail.....	77	10,792.00
Steam.....	36	17,962.00

C 10.

REMOVAL OF GREEN JACKET SHOAL, PROVIDENCE RIVER, RHODE ISLAND.

Green Jacket Shoal is in that part of Providence River which constitutes the harbor of Providence.

It lies off the wharves on the south front of the city, and occupies a part of the harbor that is required for anchorage purposes.

ORIGINAL CONDITION.

That part of the harbor in which the shoal is located is about 2,000 feet long by from 600 to 1,200 feet wide; and of this area the shoal, or rather that part of it which was included between the 15-foot curves, takes up about 18 acres. There were channels on either side of the shoal, between it and the harbor lines, having, the one on the north side a width of 300 feet and a depth of 20 feet, and the one on the south side a width varying from 50 to 100 feet and a depth of about 15 feet at mean low water. The water on the summit of the shoal was 1 foot deep.

PLANS OF IMPROVEMENT.

The general project is the removal of the entire shoal to a depth of 25 feet at mean low water, limiting the work by lines drawn 200 feet from the harbor lines.

A plat of Green Jacket Shoal was published in the Annual Report of the Chief of Engineers for 1885, vol. 1, page 599.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1888.

The amount expended, including outstanding liabilities, to June 30, 1888, was \$25,155.60. The result was the excavation to a depth of 25 feet at mean low water of an area of about 9½ acres, extending along the western side of the shoal, making an important addition to the anchorage facilities of the harbor. On a portion of this area the depth of water before the completion of the contract of November 18, 1886, was from 3 to 4 feet.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. By act of August 11, 1888, Congress appropriated \$28,000 for continuing the improvement. A project for the expenditure of this sum was accordingly prepared and was approved by the Chief of Engineers. The project contemplates commencing the work at the eastern side of the dredged area and continuing it by cuts running north and south across the shoal, as far as the funds permit.

Advertisements for proposals for dredging under this project were published December 8, 1888, and proposals opened January 8, 1889. None of the proposals were made in accordance with the specifications, and the prices bid were excessive. All the proposals were rejected and the work was re-advertised April 2, 1889. Proposals under this advertisement were opened April 23, 1889, and were also rejected. Abstracts of proposals received under both the above advertisements will be found in the appended tables.

Arrangements for continuing the work by hire of plant and labor in open market were in progress at the close of the fiscal year.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1890.

It is proposed to continue the removal of the shoal according to the general project.

Green Jacket Shoal is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence during the last fiscal year was \$260,813.27. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are Fort Adams, R. I., and the fort on Dutch Island, R. I.

Money statement.

July 1, 1888, amount available	\$1,094. 40
Amount appropriated by act of August 11, 1888.....	25,000. 00
	<hr/>
	29,094. 40
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$2,764. 94
July 1, 1889, outstanding liabilities.....	143. 83
	<hr/>
	2,908. 77
July 1, 1889, balance available	26,185. 63
	<hr/>
{ Amount (estimated) required for completion of existing project	58,096. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	50,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for removal of Green Jacket Shoal, Providence Harbor, R. I. received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated December 8, 1888, and opened at 12 o'clock noon, on Tuesday, the 8th day of January, 1889.

[To be commenced on or before March 15, 1889, and completed on or before August 15, 1889.]

No.	Name and address of bidder.	Removing bowlders exceeding 1 cubic yard, per cubic yard.	Removing other bowlders and dredging, per cubic yard.*
11	Atlantic Dredging Company, New York, N. Y.	\$25. 14	Cents.
12	W. H. Beard, Brooklyn, N. Y.		15
13	Brainard Bros., New York, N. Y.		17

* Measured in scoops.

† Informal.

Abstract of proposals for removal of Green Jacket Shoal, Providence Harbor, R. I. received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated April 2, 1889, and opened at 12 o'clock noon, on Tuesday, the 23rd day of April, 1889.

[To be commenced on or before May 15, 1889, and completed on or before July 1, 1890.]

No.	Name and address of bidder.	Removing bowlders exceeding 1 cubic yard, per cubic yard.	Removing other bowlders and dredging, per cubic yard.*
1	Atlantic Dredging Company, New York, N. Y.		Cents. 16½
12	W. H. Beard, Brooklyn, N. Y.		17½

* Measured in place.

† Informal.

COMMERCIAL STATISTICS.

For the commercial statistics, see report of the improvement of Providence River and Narragansett Bay, Rhode Island.

C II.

IMPROVEMENT OF NEWPORT HARBOR, RHODE ISLAND.

This harbor is at the main entrance to Narragansett Bay. These waters during the summer and winter constitute a harbor of refuge for our European and coastwise commerce quite equal in every respect to that of New York Harbor, and are even more accessible. The objects of the improvement are to widen and deepen the southern (the main) entrance to the harbor, and to enlarge its capacity for vessels seeking refuge in storms, by increasing the area and depth of the anchorage within it. The mean rise and fall of the tide is about 3½ feet.

ORIGINAL CONDITION.

Before improvement the capacity of the inner harbor was limited by shoals, and it was not adequate to the number and size of vessels seeking it for refuge. The southern (the main) entrance was obstructed by a bar which stretched out from Goat Island, and the general business wharves of the city could not be reached at low tide by vessels drawing more than 8 feet,

PLANS OF IMPROVEMENT.

The original project and its modifications, under which we are now working, are substantially as follows:

Deepening the southern entrance to 15 feet at mean low water and widening it by dredging Goat Island Spit northward to a line drawn from the dolphin which marks the spit to clear the permanent dock at Fort Adams by 100 feet; the excavation of a channel 750 feet wide and 15 feet deep at mean low water around and to the eastward of this dolphin; excavating to 13 feet at mean low water the area included between the 13-foot curve on the west, a line drawn from the southwest corner of Perry Mill wharf to Lime Rock on the south, the harbor line on the east, and a line drawn parallel to and 50 feet from the city wharf on the north; excavating to 10 feet at mean low water the area northwest of a line drawn from Lime Rock through the spindle, which is in the southeast part of the harbor; the excavation of a channel 10 feet deep at mean low water along and outside the harbor line south to a point opposite the gas company's wharf, and the construction of jetties on the western shore of Goat Island to arrest the drift of littoral sand and gravel into the southern entrance.

A plat of Newport Harbor, showing the plans of the work, was published in the Annual Report of the Chief of Engineers for 1885, vol. 1, page 604.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1888.

The amount expended up to the close of the fiscal year ending June 30, 1888, including liabilities outstanding at that date, was \$108,124.23, with the following results:

Of the area to be dredged to 13 feet within the harbor, about nine-tenths had been completed. The channel along and outside the harbor line south to a point opposite the gas company's wharf, and the 15-foot channel 750 feet wide around and to the eastward of the dolphin on Goat Island Spit, had been completed, with the exception of a strip along the western edge and to the north of the dolphin. The berth for vessels at the quartermaster's wharf at Fort Adams had been deepened to 10 feet at mean low water, and the littoral sand from the outside of Goat Island had been stopped for the present from washing into the channel at the southern entrance of the harbor by the construction of a jetty on the west side of the island. The southern entrance is completed for vessels of 15 feet draught, and of the total area to be dredged within the harbor (about 90 acres) about two-thirds have been completed.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. By act of August 11, 1888, Congress appropriated \$12,000 for continuing the improvement. A project for expending this sum was accordingly prepared and was approved by the Chief of Engineers. The project contemplates first the completion of the 15-foot channel by dredging along its western edge north of the dolphin; second, the completion of the dredging of the 13-foot anchorage area; and third, if the funds permit, the commencement of the 10-foot anchorage area, all of which areas are within the harbor, and, if it becomes necessary, the construction of an additional jetty on the western shore of Goat Island.

Advertisements for proposals for dredging under this project were published December 8, 1888, and proposals opened January 8, 1889. None of the proposals were made in accordance with the specifications,

and the prices bid were excessive. All the proposals were rejected, and the work was readvertised April 2, 1889. Proposals under this advertisement were opened April 23, 1889, and were also rejected. An abstract of the proposals received under both the above advertisements will be found in the appended tables.

Arrangements for continuing the work by hire of plant and labor in open market were in progress at the close of the fiscal year.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the dredging of a narrow strip along the western edge of the 750-foot channel around and to the eastward of the dolphin on the Goat Island Spit; the remainder of the excavation within the harbor of the anchorage area of 13 feet depth, and the excavation, also within the harbor, of the anchorage area of 10 feet depth; also the building of additional jetties outside of Goat Island whenever they may be required to arrest the drift of littoral sand and gravel into the harbor entrance.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1890.

It is proposed to complete the 15-foot channel as projected, and extend the anchorage area as far as possible to the east and south.

Newport is in the collection district of Newport and is a port of entry. The amount of revenue collected at Newport in the last fiscal year was \$2,901.89. The nearest light-houses are Lime Rock and Newport (Goat Island) lights. The nearest fortification is Fort Adams, Newport, R. I.

Money statement.

July 1, 1888, amount available.....		\$77.80
Amount appropriated by act of August 11, 1888.....		12,000.00
		<hr/> 12,077.80
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	1,200.65	
July 1, 1889, outstanding liabilities.....	164.33	
		<hr/> 1,364.98
July 1, 1889, balance available.....		<hr/> 10,712.82
{ Amount (estimated) required for completion of existing project.....		40,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891		30,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for dredging at Newport Harbor, Rhode Island, received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated December 8, 1888, and opened at 12 o'clock noon on Tuesday, the 8th day of January, 1889.

[To be commenced on or before March 15, 1889, and completed on or before August 15, 1889.]

No.	Name and address of bidder.	Removing bowlders exceeding 1 cubic yard, per cubic yard.	Removing other bowlders and dredging, per cubic yard.*
†1	J. H. Fenner, Jersey City, N. J.....		Cents. 34½
†2	W. H. Beard, Brooklyn, N. Y.....		35
†3	Brainard Bros., New York, N. Y.....		34½

* Measured in scoops.

† Informal.

Abstract of proposals for dredging at Newport Harbor, Rhode Island, received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated April 2, 1889, and opened at 12 o'clock noon on Tuesday, the 23d day of April, 1889.

[To be commenced on or before May 15, 1889, and completed on or before July 1, 1890.]

No.	Name and address of bidder.	Removing bowlders exceeding 1 cubic yard, per cubic yard.	Removing other bowlders and dredging, per cubic yard.*
† 1	W. H. Beard, Brooklyn, N. Y	\$0.41½	<i>Cents.</i>
2	Hartford Dredging Co., Hartford, Conn	10.00	43
3	Brainard Bros., New York, N. Y		43

* Measured in place.

† Informal.

COMMERCIAL STATISTICS.

[Furnished by Mr. J. H. Cossens, collector of customs.]

Receipts year ending June 30, 1889.

Articles.	Quantity.	Articles.	Quantity.
Spruce plank and boards.....feet..	890,000	Lime.....bbls..	17,000
Shingles.....	7,036,000	Cement.....do....	13,000
Hemlock boards.....	271,000	Brick.....	9,000,000
Pine boards.....	26,600	Lumber.....feet..	14,000,000
Laths.....	10,353,400	Hay.....tons..	1,500
Coal.....tons..	50,000	Grain.....bushels..	40,000

During the year about five thousand vessels of all classes have arrived at this port. Of these twenty-nine entered from foreign ports, and discharged cargoes valued at \$16,271.92. There are one hundred and forty-three vessels owned and hailing from this port, viz, one hundred and thirteen sail, thirty steam, the tonnage of which is 7,694.54 gross, 6,251.60 net. The tonnage of the largest vessel enrolled at this port is 728.75 gross, 718.63 net, and draws when loaded about 13 feet; the tonnage of the smallest licensed vessel is 2.75 gross, 2.17 net.

C 12.

HARBOR OF REFUGE AT BLOCK ISLAND, RHODE ISLAND.

This island is a part of the State of Rhode Island; it is 14 miles east of Montank Point, the eastern end of Long Island, and its nearest point is about 10 miles from the mainland. Besides the wants of the mackerel-fishing fleet and the general coast navigation the island is an important point on our shores for ocean navigation. It has a signal station connected by submarine telegraph with the mainland. Vessels are passing the island at all times and on all sides of it, and its position renders it of national importance. The object of the improvement is to furnish a harbor of refuge for vessels engaged in foreign and coastwise commerce. The mean rise and fall of the tide is about 3 feet.

ORIGINAL CONDITION.

Before the construction of the present harbor of refuge Block Island had no harbor which afforded protection for decked vessels. The only

ones used were open boats, which, on the approach of storms, were hauled up on the beach by oxen. The largest of these boats were of about 10 tons burden.

PLANS OF THE WORK.

The original project and its subsequent modifications provided for a harbor of refuge on the eastern side of the island, consisting of an inner harbor or basin for small vessels and an exterior harbor for large ones. The basin was to be about 250 by 300 feet in area, and inclosed, with the exception of an opening of 80 feet in width. The exterior harbor was to be formed by a riprap breakwater, which has been built. About 300 feet from the sea end of this breakwater, which is 1,000 feet long, a gap 200 feet long was left for the convenience of vessels. The present project contemplates the filling of this gap and restoring the breakwater to its original dimensions, the enlargement of the inner harbor, and the removal of a shoal along the western side of the breakwater. A plat of Block Island, showing the position of the harbor of refuge and a plan of the works, may be found in the Report of the Chief of Engineers for 1885, vol. 1, pages 612, 613.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1888.

The total expenditure up to June 30, 1888, including liabilities outstanding at that date, was \$339,008.72. The inner harbor and the main breakwater, built in prolongation of the eastern side of the inner harbor and extending 1,900 feet from the shore, were constructed in the years 1870 to 1879, inclusive. The utility of the work at once became apparent. In stormy weather the inner harbor especially was filled with fishermen and coasters, and it soon became necessary to increase its depth from 7 feet, to which it had been dredged in the first instance, to 9 feet at mean low water. A strong jetty had been built out from the cliff to the eastward of the inner harbor and a masonry wall constructed on the inside of the crib-work forming the eastern side of the inner harbor. The filling of the gap in the main breakwater had been carried to an extent sufficient to keep out the sea which was formerly driven through it into the outer harbor in easterly storms. The timber jetty filled with stone forming the shore end of the western wall of the enlarged inner harbor had been finished, and the construction of its north wall had been commenced.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year operations were in progress under a contract with William H. Molthrop & Co., which was described in the Annual Report of the Chief of Engineers for 1887, and were continued until the early part of November, 1888, when work was suspended by reason of bad weather. It was resumed in February, 1889, and completed as far as the funds applicable to this contract permitted. Three thousand five hundred and thirty tons of riprap granite were placed in the north wall of the inner harbor during the fiscal year. Mr. F. I. Angell was local inspector of the work.

By act of August 11, 1888, Congress appropriated the following amounts for continuing the improvement of this harbor: Four thousand dollars for the breakwater, \$6,000 for the inner harbor, and \$5,000 for removing sand-bar at the entrance to the harbor. A project for the application of these funds was accordingly prepared and was approved by the Chief of Engineers. The project contemplates the completion of

the filling of the gap in the main breakwater and the restoration of the breakwater to its original dimensions, the continuation of the construction of the riprap walls of the enlarged harbor, and the removal, by dredging, of the shoal extending along the western side of the breakwater. Advertisements for proposals for carrying on the work at Block Island were published, as follows:

April 3, 1889, for dredging; proposals to be opened May 3, 1889. April 3, 1889, for riprap granite for the inner harbor, and April 15, 1889, for riprap granite and chip-stone for the breakwater to be opened May 3 and 15, 1889, respectively. No proposals were received for the dredging. One bid for the inner harbor work and one for the breakwater were received. Both were rejected as excessive.

Arrangements for continuing the work by hire of labor and purchase or hire of plant in open market were in progress at the close of the fiscal year.

THE WHARF AT BLOCK ISLAND.

In the annual reports of the officer in charge for some years past attention has been called to the dilapidated and dangerous condition of the wharf. It is on the land side of the inner harbor and was built by the United States for purposes of construction of that work. Since completion of the inner harbor the only use of the wharf by the Government has been for the purpose of landing mails and supplies for the light-houses, etc. This use it is thought does not warrant an estimate for its repair or reconstruction, which would cost perhaps \$2,500.

In his annual report for the year 1886, Colonel Elliot, for reasons which were fully set forth, recommended that this wharf be turned over to the town of New Shoreham, the corporate name of Block Island, and that the following provision be attached to the item for Block Island in the next river and harbor bill:

Provided, That the wharf on the land side of the inner harbor may be turned over to the town of New Shoreham for the public use of said town; but no tolls or charges shall ever be exacted for the use of said wharf by public vessels of the United States, or freight carried in such vessels.

And I would respectfully renew the recommendation.

During the past year the wharf has been temporarily repaired by the citizens of Block Island at their own expense. The location of the wharf may be seen in the plat published at page 613 of the Annual Report of the Chief of Engineers for 1885.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the completion of the filling of the gap in the main breakwater, the restoration of the breakwater to its original dimensions, the enlargement of the inner harbor, and the removal of the sand bar formed along the western side of the breakwater.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1890.

It is proposed to apply the amount available July 1, 1889, to the continuation of the work, according to the existing project.

Block Island is in the Newport collection district, and Newport is the nearest port of entry. The revenue collected at Newport in the last fiscal year was \$2,901.89. There is no duty collected at the island. The value of the harbor is mainly as a harbor of refuge. There are several lights at the island. The nearest fortification is Fort Adams, R. I.

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Money statement.

July 1, 1888, amount available			\$776. 79
Amount appropriated by act of August 11, 1888			15, 000. 00
			<hr/> 15, 776. 79
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$1, 892. 67		
July 1, 1889, outstanding liabilities	30. 00		
			<hr/> 1, 922. 67
July 1, 1889, balance available {	Breakwater	3, 633. 78	
	Inner harbor	5, 295. 43	
	Removing sand-bar	4, 924. 91	
			<hr/> 13, 854. 12
{ Amount (estimated) required for completion of existing project			30, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891			30, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.			

Abstract of proposals for furnishing and placing riprap granite in the north wall of the inner harbor at Block Island, R. I., received at Engineer's Office, U. S. Army, Newport, R. I., in response to advertisement dated April 3, 1889, and opened at 12 o'clock noon, on Friday, the 3d day of May, 1889.

[Work to be commenced on or before May 15, 1889, and completed on or before September 15, 1889.]

No.	Name and address of bidder.	Price per ton of 2,000 pounds.
1	Wm. H. Molthrop & Co., New London, Conn.....	\$1. 72

Abstract of proposals for furnishing and placing riprap granite and chip stone on the breakwater at Block Island, R. I., received at Engineer's Office, U. S. Army, Newport, R. I., in response to advertisement dated April 15, 1889, and opened at 12 o'clock noon, on Wednesday, the 15th day of May, 1889.

[Work to be commenced on or before July 15, 1889, and completed on or before October 15, 1889.]

No.	Name and address of bidder.	Price per ton of 2,000 pounds.
1	Wm. H. Molthrop & Co., New London, Conn.....	\$1. 96

COMMERCIAL STATISTICS.

[Furnished by Hon. Nicholas Ball, Block Island.]

Report on the arrival and departure of steam and sailing vessels, together with imports and exports, to and from Block Island for the year ending December 31, 1888.

Coal received (about)	tons..	5, 500
Iron received (about)	do.....	275
Grain received (about)	bushels..	15, 500
Lumber received (about)	feet.....	4, 300, 000
General merchandise, not included in the above, imported and exported	tons..	15, 500

Arrivals and departures for the year.

Steamers from 50 to 1,000 tons, drawing from 3 to 10 feet of water.....	2, 200
Sailing vessels, from 10 to 200 tons, from 2 to 6 feet draught (about).....	116, 000

C 13.

IMPROVEMENT OF PAWCATUCK RIVER, RHODE ISLAND AND CONNECTICUT.

The navigable part of Pawcatuck River extends from the manufacturing town of Westerly to Little Narragansett Bay, into which it empties. The approach to the river is through Stonington Outer Harbor and Little Narragansett Bay, and the object of the improvement is to deepen and widen the river channel leading from this bay to Westerly.

The mean rise and fall of the tide is 2.60 feet at the mouth of the river and 2.30 feet at Westerly.

ORIGINAL CONDITION.

Before improvement the channel was crooked and obstructed by numerous shoals, on some of which there was but $1\frac{1}{2}$ feet at mean low water.

PLANS OF IMPROVEMENT.

By means of appropriations made in the years 1871-'75, the river was improved by the United States by the excavation of a channel $5\frac{1}{2}$ feet deep at mean low water and 75 feet wide below the wharves and from 35 to 40 feet wide between the lower and upper wharves. The present project contemplates the widening of the channel to 100 feet below the wharves and by an additional width of two cuts of an ordinary dredging-machine, or about 40 feet between the lower and the upper wharves, also the deepening of the entire channel to 8 feet at mean low water.

A plat of Pawcatuck River, showing the channel-lines under the present project, was published in the Annual Report of the Chief of Engineers for 1885, Part I, pages 623-625.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1888.

The amount expended on the present project up to June 30, 1888, including outstanding liabilities, was \$10,463.62, and the result was the completion of the channel to its full width and depth from the deep water opposite the village of Lottery to a point near the lower end of Major's Island, with the exception of small amounts of ledge rock which extend into the channel near Certain Draw Point and at Pawcatuck Rock.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year the work of dredging under the contract with A. J. Beardsley & Son, which was described in the Annual Report of the Chief of Engineers for 1887, was in progress and was continued until August 4, 1888, when the funds available for the work were exhausted.

During the fiscal year 8,355.6 cubic yards of material, mainly sand and gravel, and 5.92 cubic yards of bowlders over 2 tons weight were excavated from the channel.

Mr. A. H. Dickens was the local inspector of the work.

By act of August 11, 1888, Congress appropriated \$10,000 for continuing the improvement. A project for the expenditure of this sum was

accordingly prepared and was approved by the Chief of Engineers. This project contemplates extending the channel from the upper end of the work under the last contract towards Westerly as far as the funds will permit, and the removing of such small areas of ledge rock as may be uncovered by dredging, and affording such relief as the commerce may require at the shoalest places above the main work.

Advertisements for proposals for dredging under this project were published December 8, 1888. One proposal was received and was opened January 8, 1889. It was not made in accordance with the specifications, and the price bid was excessive. The proposal, therefore, was rejected and the work was re-advertised April 2, 1889. Proposals under this advertisement were opened April 23, 1889, and were also rejected. Abstracts of the proposals received under both the above advertisements will be found in the appended tables.

Arrangements for continuing the work by hire of plant and labor in open market were in progress at the close of the fiscal year.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the dredging of the channel to a depth of 8 feet at mean low water and width of 100 feet from the upper end of the present work to Westerly, and a width of 40 feet between the upper and lower wharves of that town; also the removal of the ledge rock near Certain Draw Point and Pawcatuck Rock.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1890.

It is proposed to continue the work of widening and deepening the channel, according to the new project, as far toward Westerly as the funds will admit, and also to afford such relief as the commerce of the river may require at the shoalest places in advance of the main work, and to remove the points of ledge rock referred to above.

Pawcatuck River is in the collection districts of Providence and Stonington, the dividing line passing through the river. Providence and Stonington are the nearest ports of entry. The revenue collected in the last fiscal year was: Providence, \$260,813.27; Stonington, \$1,375.50. The nearest light-houses are the Stonington and Watch Hill lights. The nearest fortification is Fort Trumbull, New London, Conn.

Money statement.

July 1, 1888, amount available	\$399.00
Amount appropriated by act of August 11, 1888.....	10,000.00
	<hr/>
	10,399.00
July 1, 1889, amount expended during fiscal year, exclusive of	
liabilities outstanding July 1, 1888.....	\$789.77
July 1, 1889, outstanding liabilities.....	35.38
	<hr/>
	825.15
July 1, 1889, balance available.....	9,573.85
	<hr/>
{ Amount (estimated) required for completion of existing project.....	16,637.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	16,637.00
{ Submitted in compliance with requirements of sections 2 of river and	
{ harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in Pawcatuck River, Rhode Island, received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated December 8, 1888, and opened at 12 o'clock noon on Tuesday, the 8th day of January, 1889.

[To be commenced on or before March 15, 1889, and completed on or before August 15, 1889.]

No.	Name and address of bidder.	Removing bowlders exceeding 1 cubic yard, per cubic yard.	Removing other bowlders and dredging, per cubic yard. *
†1	J. H. Fenner, Jersey City, N. J .....	.....	Cents. 40

* Measured in scoops.

† Informal.

Abstract of proposals for dredging in Pawcatuck River, Rhode Island, received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated April 2, 1889, and opened at 12 o'clock noon on Tuesday, the 23d day of April, 1889.

[Work to be commenced on or before May 15, 1889, and completed on or before July 1, 1890.]

No.	Name and address of bidder.	Removing bowlders exceeding 1 cubic yard, per cubic yard.	Removing other bowlders and dredging, per cubic yard. *
1	E. M. Payn, Albany, N. Y.	\$10.00	Cents. 38.9
2	Hartford Dredging Company, Hartford, Conn.	10.00	60

* Measured in place.

COMMERCIAL STATISTICS.

[Furnished by Messrs. Maxson & Co., Westerly, R. I.]

Receipts at Westerly by water.

Coal	tons..	18,894
Sand	do ..	892
Lumber	feet..	4,152,167
Bricks .....	.....	1,195,700
Grain	bushels..	71,000
Pig-iron	tons..	925

Shipments.

Stone	tons..	2,180
Number of passengers carried by steamers	(about)..	50,000

C 14.

HARBOR OF REFUGE AT STONINGTON, CONNECTICUT.

Stonington Harbor lies on the north side of the eastern entrance from the ocean into Long Island Sound, and the main object of the improvement is to furnish a harbor of refuge for vessels entering and leaving this entrance to the sound. The mean rise and fall of the tide is about $2\frac{3}{4}$ feet.

ORIGINAL CONDITION.

Originally it was an open bay, unprotected from southerly storms, and obstructed by a shoal, having a low-water depth of but 6 feet at the shoalest part. This shoal nearly filled the inner harbor, and left but a narrow channel on either side of a depth insufficient to permit vessels of 12 feet draught to reach the upper wharves at low water.

PLANS OF THE WORK.

A short breakwater was constructed in the years 1828-'31, at a cost of \$34,766.65, for the protection of the commerce of the town of Stonington. The enlarged project of 1871 for the improvement of Stonington Harbor and its subsequent modification, under which work is now carried on, embraced dredging in the upper harbor and the construction of two breakwaters in the outer harbor. One of these (the western) was to be built out from Wamphassuck Point, the southwest limit of the harbor, and to extend about 2,000 feet, and the other (the eastern) was to extend from the vicinity of Bartlett's Reef to the Middle Ground. The western breakwater was completed in 1880, at a cost of \$103,190. The amount expended in dredging in the upper harbor was about \$45,000. The position of the western end of the eastern breakwater has not been determined, but it will probably be found necessary, in order to afford all the protection desired, to extend the breakwater at least until it intersects a range from Stonington Light to the middle of Wicopessit Island. It may then be found desirable to carry it still further, possibly to the range from Stonington Light to the eastern end of Fisher's Island.

A plat of this harbor, showing the position of the breakwaters, was published in the Annual Report of the Chief of Engineers for 1884, page 632.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1888.

The amount expended upon the eastern breakwater up to the close of the fiscal year ending June 30, 1888, including liabilities outstanding at that date, was \$109,548.90, and its length at that date was 2,210 feet.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. By act of August 11, 1888, Congress appropriated \$8,000 for continuing the improvement. A project for the expenditure of this sum was accordingly prepared and was approved by the Chief of Engineers. The project contemplates extending the eastern breakwater to the westward as far as the funds will permit.

Advertisements for proposals for furnishing riprap granite under this project were published December 17, 1888, and proposals opened January 17, 1889. An abstract of the proposals received and the terms of the contract will be found in the appended table.

Work under this contract was commenced March 25, 1889, and was in progress at the close of the fiscal year. During the year 3,664.5 tons of riprap granite were placed in the breakwater.

Mr. C. O. Abell, until May 6, and Mr. F. I. Angell from that date to the end of the fiscal year were local inspectors of the work.

AMOUNT EXPENDED DURING THE LAST FISCAL YEAR AND RESULTS TO JUNE 30, 1889.

The amount expended during the last fiscal year, including liabilities outstanding June 30, 1889, was \$5,440.76, and the result was the extension of the eastern breakwater to a point about 2,240 feet from its eastern extremity, or about .87 of the shorter of the alternative lengths projected.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is to finish the construction of the eastern breakwater. In case it be found that sufficient protection to the harbor of refuge has been afforded when the range from Stonington Light to the middle of Wicopessit Island is reached, the length of the breakwater yet to be built is about 330 feet. Should it be decided to extend it to the middle ground, it will require about 150 feet more.

By reason of the great danger to the large passenger steamers of the Stonington Line (New York and Boston), caused by the western end of the breakwater, especially in foggy and thick weather, and which will continue to exist until it is completed and a light-house and fog-signal are erected upon it, it is very desirable that the whole amount necessary to finish the breakwater should be included in one appropriation. A temporary light was placed on the western end of the breakwater in March last and has since been maintained.

The completion of this work will afford a thoroughly protected anchorage for vessels drawing 18 feet of water, and a harbor of refuge for the commerce which daily passes between Long Island Sound and the eastward.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1890.

It is proposed to extend the eastern breakwater further to the westward.

Stonington Harbor is in the Stonington collection district and is a port of entry. The amount of revenue collected at Stonington in the last fiscal year was \$1,375.50. The principal value of the harbor is as a harbor of refuge. The nearest lights are Stonington Light and Latimer's Reef Light. The nearest fortification is Fort Trumbull, New London Harbor, Connecticut.

Money statement.

July 1, 1888, amount available.....	\$450. 80
Amount appropriated by act of August 11, 1888.....	8,000. 00
	<hr/> 8,450. 80

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$3,485. 46
July 1, 1889, outstanding liabilities.....	1,955. 30
July 1, 1889, amount covered by existing contracts.....	2,097. 20
	<hr/> 7,537. 96

July 1, 1889, balance available.....	912. 84
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{ Amount (estimated) required for completion of existing project.....	25,000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	25,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

640 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

Abstract of proposals for furnishing and placing riprap granite in the eastern breakwater at Stonington, Conn., received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated December 17, 1888, and opened at 12 o'clock noon, on Thursday, the 17th day of January, 1889.

[Work to be commenced on or before March 15, 1889, and completed on or before August 15, 1889.]

No.	Name and address of bidder.	Price per ton of 2,000 pounds.
1	Charles F. Stoll, New London, Conn.	\$1.07
2	James Scully, Groton, Conn.	1.29
3	William H. Malthrop & Co., New London, Conn.	1.27
4	James V. Luce, Niantic, Conn.	1.27
5	Francis H. Smith, New York, N. Y.	1.67

Contract awarded to Charles F. Stoll, of New London, Conn., with the approval of the Chief of Engineers, and dated February 8, 1889.

COMMERCIAL STATISTICS.

[Furnished by Mr. H. G. Palmer, deputy collector.]

Number of vessels entering from foreign ports.....	8
Number of vessels cleared for foreign ports	8
Value of merchandise imported.....	\$6, 037.00
Amount of duties collected.....	\$1, 375.50
Estimated value of cargoes coastwise.....	\$36, 000, 000.00
Estimated value of cargoes shipped coastwise.....	\$34, 500, 000.00
Value of product of fisheries	\$100, 000.00
Number of vessels seeking harbor for refuge	2, 400
Number of vessels registered in district.....	113
Tonnage, gross	6, 322.38

C 15.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

WRECK OF SCHOONER ALMA.

The schooner *Alma* was a vessel of about 200 tons burden, and was probably built in 1882 at Alma, New Brunswick. The name of the owner was not ascertained. She was loaded with lime and a deck load of lumber. The vessel caught fire somewhere off the coast of Cape Cod during the storm of September 26, 1888, and was towed to Vineyard Haven, Mass., and left by the tow-boat at a shoal spot about 1,200 feet northeast of the steam-boat wharf. She lay in about 10 to 12 feet of water, and from her position on the edge of the channel was a dangerous obstruction to navigation. The notice required by section 4 of the river and harbor appropriation act of June 14, 1880, was given to all persons interested in the vessel, etc., by publication in newspapers, and no action having been taken by the owners looking to the removal of the wreck, proposals for the work were invited by advertisement dated January 12, 1889. An abstract of the proposals received and the terms of the contract will be found in the appended table.

The contractor at first attempted to float the wreck by means of casks. This method was found to be impracticable and was abandoned, and the wreck blown up by dynamite. The cargo of lime was cleaned out with a steam-shovel.

The work was greatly delayed by bad weather and high winds. It was completed May 1, 1889. Portions of the rigging and hull of the vessel were saved during the process of removal. They were sold at auction at Vineyard Haven, and the proceeds, amounting to \$108, were covered into the Treasury.

Mr. C. O. Abell, to March 25, 1889, and Mr. George F. Rostock, after that date, were local inspectors of the work.

Abstract for proposals for removing the wreck of the schooner Alma received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated January 12, 1889, and opened at 12 o'clock noon on Tuesday, the 12th day of February, 1889.

No.	Name and address of bidder.	Amount of bid.
1	William Buckley, Vineyard Haven, Mass	\$770
2	Hibbard Youngs, New London, Conn	777
3	Lincoln Foster Baker, Boston, Mass	1,000
4	George W. Townsend, Boston, Mass	1,197
5	Charles W. Johnston, Lewes, Del	1,375
6	Charles E. Davis, Wood's Holl, Mass	1,440
*7	Harvey S. Cook, Agent Boston Tow-Boat Company, Vineyard Haven, Mass	2,200

* Informal and not in triplicate.

Contract awarded to William Buckley, of Vineyard Haven, Mass., with the approval of the Chief of Engineers, and dated February 26, 1889.

Work to be commenced within ten days after signing the contract and completed within forty days of the time of commencement.

WRECK OF SCHOONER ANNIE E. HAYES.

According to the best information obtainable the schooner *Annie E. Hayes* was owned by W. W. Baker, of Brooklyn, N. Y., who was also her captain. Her dimensions were approximately, length 150 feet, breadth 14 feet, depth from top of rail to bottom of keel 10 feet. She was bound from East Wareham, Mass., to Providence, R. I., with a cargo of 160 tons of molding sand, and between 10 and 11 o'clock on the morning of December 5, 1888, sprung a leak and went down, giving the captain and crew barely time to escape in the small boat. The wreck lay in about 22 feet of water about 1 mile south of Bird Island Light, Buzzard's Bay, Massachusetts, directly in the track of vessels bound in and out of Wareham River. Wreckers stripped her of everything of value except the masts. Her cabin was found on the beach a few days after the accident.

The notice required by section 4 of the river and harbor appropriation act of June 14, 1830, to all persons interested in the vessel, etc., was given by advertisement in newspapers, and proposals for removing the wreck were invited. No action having been taken by the owners, the proposals were opened March 18, 1889.

An abstract of the proposals received and the terms of the contract will be found in the appended table.

Dynamite was used to remove the wreck. The work was considerably delayed by unfavorable weather. It was completed May 1, 1889. Mr. F. I. Angell was local inspector of the work.

Abstract of proposals for removing wreck of schooner Annie E. Hayes received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated February 15, 1889, and opened at 12 o'clock noon on Monday, the 18th day of March, 1889.

No.	Name and address of bidder.	Amount of bid.
1	Charles E. Davis, Wood's Holl, Mass.....	\$540
2	George W. Townsend, Boston, Mass.....	200
3	Hiram W. Phillips, Quincy Point, Mass.....	1,000
4	Charles W. Johnston, Lewes, Del.....	1,100
5	Hibbard Youngs, New London, Conn.....	1,200

Contract awarded to Charles E. Davis, of Wood's Holl, Mass., with the approval of the Chief of Engineers, and dated April 5, 1889.

Work to be commenced within ten days after signing the contract, and completed within forty days of the time of commencement.

C 16.

PRELIMINARY EXAMINATION OF ENTRANCE TO POINT JUDITH POND, WEST OF POINT JUDITH, RHODE ISLAND, WITH A VIEW TO ESTABLISHING A HARBOR OF REFUGE.

ENGINEER OFFICE, U. S. ARMY,
Newport, R. I., December 14, 1888.

GENERAL: In compliance with instructions contained in Department letter of September 29, 1888, I have the honor to submit the following report upon the preliminary examination of entrance to Point Judith Pond, west of Point Judith, Rhode Island, provided for in the river and harbor act of August 11, 1888, and made by Capt. T. L. Casey, Corps of Engineers, on the 11th October last:

Point Judith Pond is located in the southeastern part of the town of Kingston, R. I.; is about 3 miles in length, and varies from one-half mile to 1 mile in breadth. It is connected with the ocean by a narrow, tortuous channel having a depth of from 3 to 8 feet at mean low water.

The low-water level in the pond is about 2.5 feet above that of the ocean. The mean range of the tide in the latter is about 3 feet, and in the former is said to vary from 6 to 9 inches.

A careful survey of this locality was made in 1873, under the direction of General Warren, a report on which may be found in the Annual Report of the Chief of Engineers for 1874, pages 117-120.

The examination just made by Captain Casey shows that since the date of General Warren's report the branch forming the outlet to the pond has materially deepened and that the level of the pond has been somewhat reduced. It was found in 1873 that this level was 4.5 feet above mean low water, and the water almost entirely fresh. Captain Casey estimates that the low level of the pond can not be more than 2.5 feet above low tide in the ocean, and at high tide strong currents enter the pond, and further states that if a navigable channel 200 feet wide and 7 feet deep were excavated as indicated on the diagram marked A the depth of the pond would be reduced by that much.

On the accompanying sketch the curves of equal depth have been plotted from the map of General Warren's survey.

Captain Casey says "it would be perfectly feasible to excavate a channel into the entrance of the harbor to a depth of 7 feet at mean low tide." He estimates that this would produce a tidal current of about 3 miles per hour, and that the depth of the pond would thereby be reduced about 2.5 feet.

A harbor of refuge might also be established at the entrance to the pond with the same facility as at any other point on the sea-coast which afforded no material advantages therefor, but could not be maintained unless by constant dredging.

The cost of building breakwaters to inclose an area of one-fourth of a square mile, with an average depth of 20 feet, is roughly estimated at \$800,000, and the original cost of excavating a channel into the pond to a depth of 7 feet at mean tide is roughly estimated at \$40,000. Perhaps it could be maintained by an annual expenditure somewhat less than this amount.

General Warren, in his report on this locality, says:

To secure an artificial enlargement of the outlet, extensive stone jetties would be required on each side to prevent the opening being filled with sand, and even these, unless of very great extent, would be of doubtful effect, for the beach is composed of shifting sand, exposed to the full force of the ocean waves.

The village of Wakefield is situated at the head of this pond, and if vessels of moderate draught can be made to reach it the people would be much benefited; but the cost of making suitable works to effect this would be so great that nothing but the commerce of a great city like New York would justify the attempt. There, an artificial harbor costing millions could be afforded, and only under its shelter could the beach be kept permanently open. I therefore submit no estimate for improvement.

The present and prospective demands of commerce justify a small harbor of refuge in this vicinity. Such a harbor is recommended in my report of the preliminary examination of coast near life-saving station, East Point Judith, which is about 2 miles east of the entrance to Point Judith Pond.

In my opinion the entrance to Point Judith Pond, west of Point Judith, is not worthy of improvement, with a view to constructing a harbor of refuge. A copy of Captain Casey's report is inclosed with my report of preliminary examination of East Point Judith.*

Point Judith Pond is in the collection district of Newport, which is a port of entry. The amount of revenue collected at Newport in the last fiscal year was \$2,184.51. The nearest light-house is Point Judith Light. The nearest fortification is the fort on Dutch Island, Rhode Island. The population of South Kingston by the Rhode Island State census of 1885 was 5,549.

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF CAPTAIN THOMAS L. CASEY, CORPS OF ENGINEERS.

ENGINEER OFFICE, U. S. ARMY,
Newport, R. I., October 12, 1888.

SIR: The following is a report of the preliminary examination of Point Judith Pond and the coast-line thence to Point Judith, R. I., with a view to the establishment of harbors of refuge.

* Copy submitted herewith.

On the morning of October 11 the party set out from the upper end of the upper pond in a small steam-launch belonging to Mr. J. P. Robinson and brother, of Wakefield. A sounding-rod had been provided graduated to feet. Soundings were taken at intervals of about a fifth of a mile. The course lay down the upper pond to the Narrows; thence in a nearly straight course to the interval between Gardiner's Island and a smaller island lying immediately to the eastward and thence in a gentle curve to High Point.

As indicated on the accompanying map, the soundings taken show that from the upper end of the pond to a point nearly opposite Buf Island, a distance of about 2 miles, a channel depth of about 10 feet can easily be obtained; but from the latter point to the entrance the depth became rapidly less, and in order to obtain sufficient depth of water for commercial purposes extensive dredging will be necessary.

At a point about one-half a mile below High Point the party left the launch because of the eel-grass, which impeded the propeller, and took to a flat-bottom skiff. As we approached the entrance along the dotted line on the map it could be seen that there was a perceptible current setting into the pond and into the narrow passage forming its outlet. This current became so strong that headway could be made with difficulty against it. The depth in the narrow, tortuous outlet varied from 3 to 8 feet. The tide was at its full and there was no appearance of a bar at the entrance. As the mean range of the tide on the coast is about 3 feet and as the known range of the tide in the pond is from 6 to 9 inches it follows that the low level of the pond can not be much more than 2.5 feet above mean low tide in the ocean, and that if a navigable channel 200 feet wide and 7 feet deep (at mid-tide) was excavated, as indicated on the diagram marked A, the depth in the pond would be reduced by that amount at low tide. By a rough calculation, assuming the area of the pond to be $1\frac{1}{2}$ square miles, such an outlet as that just indicated would accommodate the incoming and outflowing tide with a current of 3 miles per hour. If a row of guide-piling sheathed with planks be driven along the borders of the artificial channel and out off at a height of 8 feet above the high-water level it would serve to retain the current for purposes of deepening the channel and would at the same time serve as a catch for the loose sand, which is sometimes extensively shifted by the wind.

If a harbor of refuge is to be built on the coast to the westward of Point Judith it would seem that the best location for it would be at the entrance of this pond, where it would serve at once as harbor of refuge and as a quiet port wherein vessels might discharge cargoes upon lighters which could then be towed up the pond to Wakefield.

There is no part of the coast between the entrance and Point Judith which could be advantageously chosen as a site for the harbor because of a long ledge which extends for nearly a mile in a south by easterly direction from a point nearly one-half mile from the shore near the entrance of the pond. This ledge would effectually bar the progress of any vessel drawing more than 13 feet of water and its attempt to reach such a harbor from the southwest, and would at all times be dangerous.

The position of the proposed harbor is indicated on the map.

Proceeding to the life-saving station at Point Judith, the captain of the crew was asked his opinion as to the position and nature of the proposed breakwater to the north of the point. The position of the breakwater, as traced by him, is shown on the map, and it was suggested that a small prolongation at right angles to the axis and from its extremity would be very useful, and such a form far superior to the arc of a circle.

If the breakwater be built in this position it is suggested that it be capped with large rough-finished stones, so that it could serve some of the purposes of a dock.

On reviewing the entire project, which although threefold in its nature is in reality only one, it should be said in conclusion that it is quite possible, and, as far as the Wakefield harbor of refuge and the Point Judith breakwater are concerned, almost a necessity.

Appended (marked B) there is a list of the vessels which have been wrecked on this coast from the Point Judith Pond Inlet to a point midway between the point and Narragansett Pier. It was very obligingly furnished by the captain of the life-saving crew.

Very respectfully, your obedient servant,

THOS. L. CASEY,
Captain of Engineers.

Maj. W. R. LIVERMORE,
Corps of Engineers.

B.—List of vessels wrecked near Point Judith, 1883-'88.

Names wrecked.	When wrecked.	Valuation of vessels.	Valuation of cargo.	Nature.
Schooner Warren Gates	Mar. 25, 1883	\$4,000	\$6,500	Steel wire.
Schooner Thomas E. Pillsbury	June 13, 1883	28,000	2,500	Coal.
Schooner Julia A. Tate	May 10, 1884	4,000	3,500	Log-wood and axles.
Schooner Idlewild	June 6, 1884	2,000	1,125	Grain.
Schooner Almon Bacon	Nov. 5, 1885	3,000	2,000	Iron.
Schooner Mott Haven	Dec. 25, 1885	6,000	1,900	Furniture and oil.
Schooner Willie DeWolf	do.	3,000	1,500	Lumber.
Schooner Allen Greene	Jan. 9, 1886	12,000	No cargo.	Ballast.
Steamer Miranda	June 20, 1886	110,000	31,500	General cargo.
Schooner Mary Natt	Dec. 1, 1886	1,200	2,700	Iron.
Schooner Harry A. Barry	Feb. 20, 1887	25,000	4,275	Coal.
Schooner Mary A. Drury	Dec. 31, 1887	10,000	2,000	Do.
Brig John Welsh, jr.	Mar. 3, 1888	1,500	1,200	Do.
Schooner Maggie J. Smith	Nov. 10, 1887	35,000	5,000	Do.
Schooner Henry H. Olds	Apr. 12, 1888	45,000	5,000	Do.
Schooner Anita	May 2, 1888	3,000	1,900	Lumber.
Schooner Earl P. Mason	Aug. 22, 1888	17,000	3,000	Coal.
Schooner Isaac H. Borden	Sept. 9, 1888	500	3,000	Oil.

Total number of wrecks, 18; total valuation of vessels, \$310,200; total valuation of cargo, \$78,500.

C 17.

PRELIMINARY EXAMINATION OF WESTPORT HARBOR AND EAST AND WEST BRANCH OF WESTPORT RIVER, MASSACHUSETTS.

ENGINEER OFFICE, U. S. ARMY,
Newport, R. I., December 14, 1888.

GENERAL: In compliance with instructions contained in Department letter of September 29, 1888, I have the honor to submit the following report upon the preliminary examination of Westport Harbor and East and West Branch of Westport River, Massachusetts, provided for in the river and harbor act of August 11, 1888, and made by Maj. W. R. Livermore, Corps of Engineers, and Mr. Edward Parrish, assistant engineer, on the 13th November last.

Westport Harbor is an estuary on the coast of Massachusetts, lying between Narragansett Bay, Rhode Island, and Buzzard's Bay, Massachusetts. The continuations northward of this estuary are known as the East and West Branches of Westport River; the former has a width of about three-fourths of a mile for some 4 miles from its mouth, and the latter is about one-half mile wide for 3 miles of its length. Both of these branches are included in the town of Westport, Bristol County, Massachusetts.

The village of Adamsville, in the town of Little Compton, R. I., lies at the head of navigation of the West Branch.

The entrance from the harbor of Westport to the West Branch of the river is somewhat obstructed by a shoal known as the "Lion's Tongue," but with this exception the branch has a navigable channel of about 10 feet at mean low water up to a point some three-fourths of a mile below Adamsville. This channel could be maintained and somewhat improved at an expense of a few hundred dollars, which might properly be undertaken by the General Government, if there were any wharves or other facilities for landing cargoes at the upper end, or any probable demand for such a channel.

A steamer drawing 6 feet of water runs regularly between Fall River and Adamsville during the summer and occasionally in winter, but can only reach the latter point for about one hour at extreme high tides, through a narrow and very tortuous channel.

The first cost of excavating a channel to Adamsville, for vessels drawing 10 feet, is roughly estimated at \$6,000. The present demands of commerce do not appear to justify the expenditure of this sum. A good road about 4 miles long leads from Adamsville to Westport Harbor, one of the points now under consideration.

The head of navigation of the east branch of Westport River is at Westport Point. Vessels drawing 7 feet can reach this point at all stages of tide, and according to the best information I have been able to obtain after considerable inquiry there is no demand of commerce or desire of the citizens of the several villages or towns lying on or near this branch for any improvement of it above Westport Point.

It appears to me that the commercial requirements of the communities of Westport Harbor and on the branches of the river can best be obtained by the expenditure of about \$2,000 in extending the jetty on Horse Neck Point or building other structures, and perhaps by dredging a little in Westport Harbor.

In my opinion Westport Harbor is worthy of further improvement by the General Government. The cost of a survey of the locality is estimated at \$150.

A sketch showing the location of the proposed improvement, and one of the neighboring country, are herewith inclosed.

Westport Harbor and River are in the New Bedford collection district. New Bedford is the nearest port of entry. The amount of revenue collected at New Bedford in the last fiscal year was \$29,023.98. The nearest light-house is Seaconnet Light. The nearest fortification is the fort at Clark's Point, New Bedford, Mass. The population of Westport, Mass., by the United States census of 1880, was 2,894, and that of Little Compton, by the Rhode Island State census of 1885, was 1,055.

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. Army.

LETTER OF POSTMASTER OF ADAMSVILLE, RHODE ISLAND.

ADAMSVILLE, R. I., December 13, 1888.

DEAR SIR: I was very sorry not to have met you when you came to Adamsville, R. I., that I might have given you an aggregate of the amount of business done in this place and the consequent necessity of better water communication to and from this place. In the first place we are remote from any railroad communication, our nearest station being 10 miles distant. This compels us to look for less expensive ways of transporting goods, etc., to this place, and the best and cheapest way is by water. In this way we have brought to this place yearly:

Coal, about	\$2, 000
Lumber, about	5, 000
General merchandise.....	20, 000
Grain.....	40, 000

Also quantities of produce to ship away, and the barrier against progress in our doubling our sales and increasing the growth and prosperity of this section is largely due to the bad channel communication between Westport Harbor and Adamsville. In the west branch of Westport River the channel wants widening, and in some places deepening, and several rocks located in the bottom of the channel want removing. In many places the channel wants straightening, and with an outlay of probably \$6,000 or \$7,000 this place could be reached with vessels drawing 7 or 8 feet of water, and with the dispatch necessary to success.

Mr. William Valentine, of Westport Point, Mass., has carefully looked into this matter and thinks this the only way that this place (Adamsville) can ever be successfully reached.

Hoping this may meet with your approval, and that it may be surveyed soon so that the report may be sent in at the coming meeting of Congress,

I remain yours, very respectfully,

ABRAHAM MANCHESTER, P. M.

Maj. W. R. LIVERMORE,
Corps of Engineers.

P. S.—I inclose a few of the many names of our people who are interested in this enterprise and desirous of having the survey, and hope for an appropriation in the near future.

Yours truly,

ABRAHAM MANCHESTER.

PETITION OF THE CITIZENS OF ADAMSVILLE, RHODE ISLAND.

DEAR SIR: We, the undersigned, would respectfully represent and petition your honorable body, asking that a survey may be made of the west branch of Westport River from Westport Harbor to Adamsville, beginning at a point in the channel called the Lion's Tongue, which needs widening, thence to Adamsville Wharf. The channel in most places needs widening and deepening to accommodate the steamboats and sailing-vessels which are in constant use on this river, transporting merchandise, grain, and produce. We would also ask that this survey might be made so that a report of the same may be made to the committee at the next meeting of Congress.

[Signed by Capt. O. P. Head and eighty-one others.]

Maj. W. R. LIVERMORE,
Corps of Engineers.

C 18.

PRELIMINARY EXAMINATION OF TAUNTON RIVER, MASSACHUSETTS.

ENGINEER OFFICE, U. S. ARMY,
Newport, R. I., December 29, 1888.

GENERAL: In compliance with Department letter of September 29, 1888, I have the honor to submit the following report of the preliminary examination of Taunton River, Massachusetts, provided for in the river and harbor act of August 11, 1888:

Taunton River rises in Norfolk County, Mass., and empties into Mount Hope Bay, a name given to the northeast part of Narraganset Bay. It is 44 miles in length, measured along its course. It has been improved by the United States under appropriations made in the years 1852-1884, amounting to \$160,000. The object of the improvement is to deepen and widen the channel leading to the city of Taunton, at the head of navigation, which requires large quantities of coal, iron, clay, molding-sand, and other heavy articles for its manufactories, depending largely on water transportation, so that vessels of 11 feet draught can reach the city at high water.

In its original condition the channel was narrow and obstructed by bowlders, and in some places the depth was not more than 5 feet at high water. A vessel of 30 tons burden was as large as could go up to Taunton.

The project under which the work was carried on provided for a channel of the following dimensions:

From Weir Bridge to the ship-yard, 60 feet wide, 11 feet deep; from ship-yard to and through the "Needles" and Brigg's Shoal, 80 feet wide, 100 feet at the bends, 11 feet deep; from Brigg's Shoal to Berk-

ley Bridge, 80 feet wide, 100 feet at the bends, 12 feet deep; from Berkley Bridge to the deep water at Dighton, 100 feet wide, 12 feet deep.

The depths are estimated from high water. The ledge which crossed the bottom of the river at Peter's Point, and the numerous bowlders which lay on the bottom and sides of the channel from Taunton to Dighton, were to be removed.

This project has been completed, with the exceptions that but 40 feet of the 60 feet of width could be dredged between the bridge at Weir and the ship-yard, on account of interfering with private property, and that, on account of the hardness and depth of the material at the sides the 80-foot channel was not in all cases dredged to its full width between the ship-yard and Berkley Bridge.

During the working season of 1887 a small amount of ledge rock above the plane of the bottom of the channel was uncovered by the dredging below Peter's Point. After the removal of this the channel below Berkley Bridge will be completed.

The object of the further improvement of the river is the widening of the 80-foot channel to its full dimensions where it is too narrow, the removal of the bowlders obstructing the channel between Berkley Bridge and Taunton, and the removal of the small amount of ledge rock in the channel below Peter's Point.

In compliance with the river and harbor act of August 5, 1886, a preliminary examination and survey were made of this river, the reports upon which, together with a map of the survey, were published in House Ex. Doc. No. 86, Fiftieth Congress, first session.

The following extracts are taken from the report of the survey; also the accompanying map. The areas in which it is proposed to dredge are shaded on the accompanying map and are in the following localities:

(1) At the points indicated from just below Pioneer Rock to about 300 feet above the mouth of Three-Mile River.

(2) At Burt's Turn.

(3) At Pond Rock's Shoal.

(4) In the upper part of the channel at Weir Village.

(5) It is also proposed to remove the small amount of ledge rock uncovered in dredging between Peter's Point and Dighton, and to remove the bowlders in and near the channel between Berkley Bridge and Weir.

The estimated cost of completing the approved project is \$14,051.

The channel as projected is shown on the map by a broken and dotted line. There is also shown, in the localities referred to above, a full line indicating a channel 60 feet wide in the narrowest places and 90 feet wide at the bends, which, it is estimated, could be completed for \$4,500.

No new facts bearing on the question have been brought to my notice since the date of my report of November 21, 1887, on the survey made in October of that year.

No further survey of the river is required to comply with the provisions of the river and harbor act of August 11, 1888.

In my opinion, Taunton River is worthy of improvement, according to the project already approved. The estimated cost of completing this improvement is \$14,051.

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

C 19.

PRELIMINARY EXAMINATION OF FISHING-PLACE COVE, NEAR SEACONNET POINT, RHODE ISLAND, WITH VIEW TO CONSTRUCTING A BREAK-WATER.

ENGINEER OFFICE, U. S. ARMY,
Newport, R. I., December 14, 1888.

GENERAL: In compliance with instructions contained in Department letter of September 29, 1888, I have the honor to submit the following report upon the preliminary examination of Fishing-Place Cove, near Seaconnet Point, Rhode Island, provided for in the river and harbor act of August 11, 1888, and made by me on the 30th of October last.

Fishing-Place Cove is about three-fourths of a mile north of Seaconnet Point, in the southwestern part of Little Compton Town, Newport County, R. I.

In 1827 this point, known as Church's Cove, was surveyed by Lieutenant-Colonel Anderson, of the Topographical Engineers and Lieutenant Prescott, First Artillery, who prepared a project for a breakwater here, extending north about 400 feet from the rock forming the southwestern limit of the cove.

On visiting the site I found the remains of an old breakwater which appeared to have been built for about 200 feet from shore, and all but the shore end in ruins. A wharf had been built immediately to the east of this, for a steam boat landing.

The inhabitants of the neighborhood told me that they had petitioned to have this breakwater rebuilt. Isaac W. Howland writes from Little Compton that he is the agent of the steamer *Queen City* and would like to have the breakwater extend out to a certain rock about 250 feet from shore. A copy of his letter is forwarded herewith.

This is the only landing place on the shores of Little Compton; it is important to the fishing interests, and if protected by a breakwater would form a convenient harbor of refuge for small vessels navigating the coast.

It is roughly estimated that for \$5,000 the breakwater could be restored for at least a portion of its length, and a small area inside the cove could be dredged so as to somewhat increase the anchorage area for small vessels. In my opinion Fishing-Place Cove is worthy of improvement by the General Government, and I estimate the cost of a survey of the locality at \$200.

Seaconnet River is in the collection district of Newport, which is a port of entry. The amount of revenue collected at Newport in the last fiscal year was \$2,184.51. The nearest light-house is Seaconnet Light; the nearest fortification is Fort Adams, Newport, R. I. The population of Little Compton by the Rhode Island State census of 1885 was 1,055.

A tracing of Lieutenant-Colonel Anderson's map of 1827, showing the location of the proposed improvement, is herewith inclosed.

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

LETTER FROM MR. ISAAC W. HOWLAND.

LITTLE COMPTON, November 16, 1888.

SIR: In relation to the breakwater at Seaconnet Point, we as owners of steamer *Queen City* want one to extend out to a certain rock that is about 250 feet from shore.

Our boat is over 100 feet long and it is impossible to lay here over night with a fresh breeze. As many as thirty vessels make harbor here at times. With such a breakwater the steamer could stay over night, and be a better harbor for others. Any other information required would be glad to give you.

Yours, respectfully,

Major LIVERMORE.

ISAAC W. HOWLAND,
Agent Queen City.

C 20.

PRELIMINARY EXAMINATION OF GREENWICH BAY, TO DEEPEN WATER ON THE BAR AT LONG POINT, RHODE ISLAND.

ENGINEER OFFICE, U. S. ARMY,
Newport, R. I., December 14, 1888.

GENERAL: In compliance with instructions contained in Department letter of September 29, 1888, I have the honor to submit the following report upon the preliminary examination of Greenwich Bay, Rhode Island, provided for in the river and harbor act of August 11, 1888, and made by Capt. Thomas L. Casey, Corps of Engineers, on the 19th October last.

Greenwich Bay is an arm of Narragansett Bay, and is located in Warwick and East Greenwich towns, Kent County, R. I. It has a length from northwest to southeast of about three and one-half miles and an average width of about one and one-half miles. The town of East Greenwich is located on the southwestern shore of the bay.

Captain Casey's report, herewith inclosed, explains the nature of the improvement desired as well as the demands of commerce. The cost of the improvement is roughly estimated at \$2,000.

In my opinion Greenwich Bay is worthy of improvement by the General Government, and I estimate the cost of a survey of the locality at \$250.

Greenwich Bay is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence in the last fiscal year was \$22,195.01. The nearest light-house is Warwick Light. The nearest fortification is the fort on Dutch Island, Rhode Island. The population of East Greenwich by the Rhode Island State census of 1885 was 2,659, and that of Warwick was 13,286.

A Coast Survey map of Greenwich Bay, showing the location of the proposed improvement, is herewith inclosed.

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

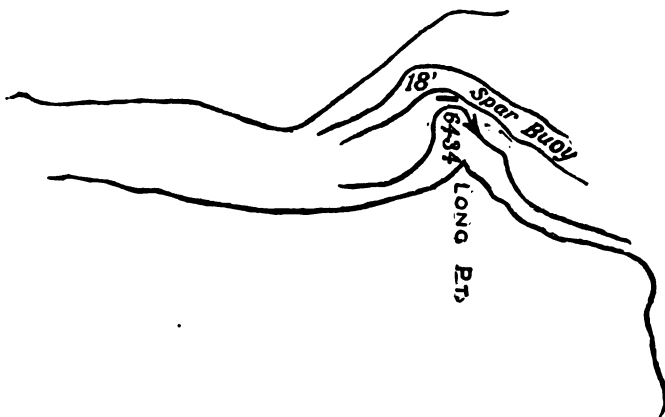
REPORT OF CAPTAIN THOMAS L. CASEY, CORPS OF ENGINEERS.

ENGINEER OFFICE, U. S. ARMY,
Newport, R. I., October 20, 1888.

MAJOR: I have the honor to submit the following report of a preliminary examination of the bar near Long Point, harbor of East Greenwich, R. I.

October 19 I proceeded to East Greenwich and was conveyed in a row-boat to the bar in question, which is a submarine continuation of Long Point. Between Long Point and the opposite shore there is a spar-buoy in the position marked on the ac-

accompanying diagram. The tide was at low stage at the time the soundings were taken. The latter indicate low-water depths of from 3 to 7 feet from Long Point to the spar-buoy, between which and the opposite shore there is ample depth for purposes of navigation. I understood that the depth of water was entirely satisfactory,



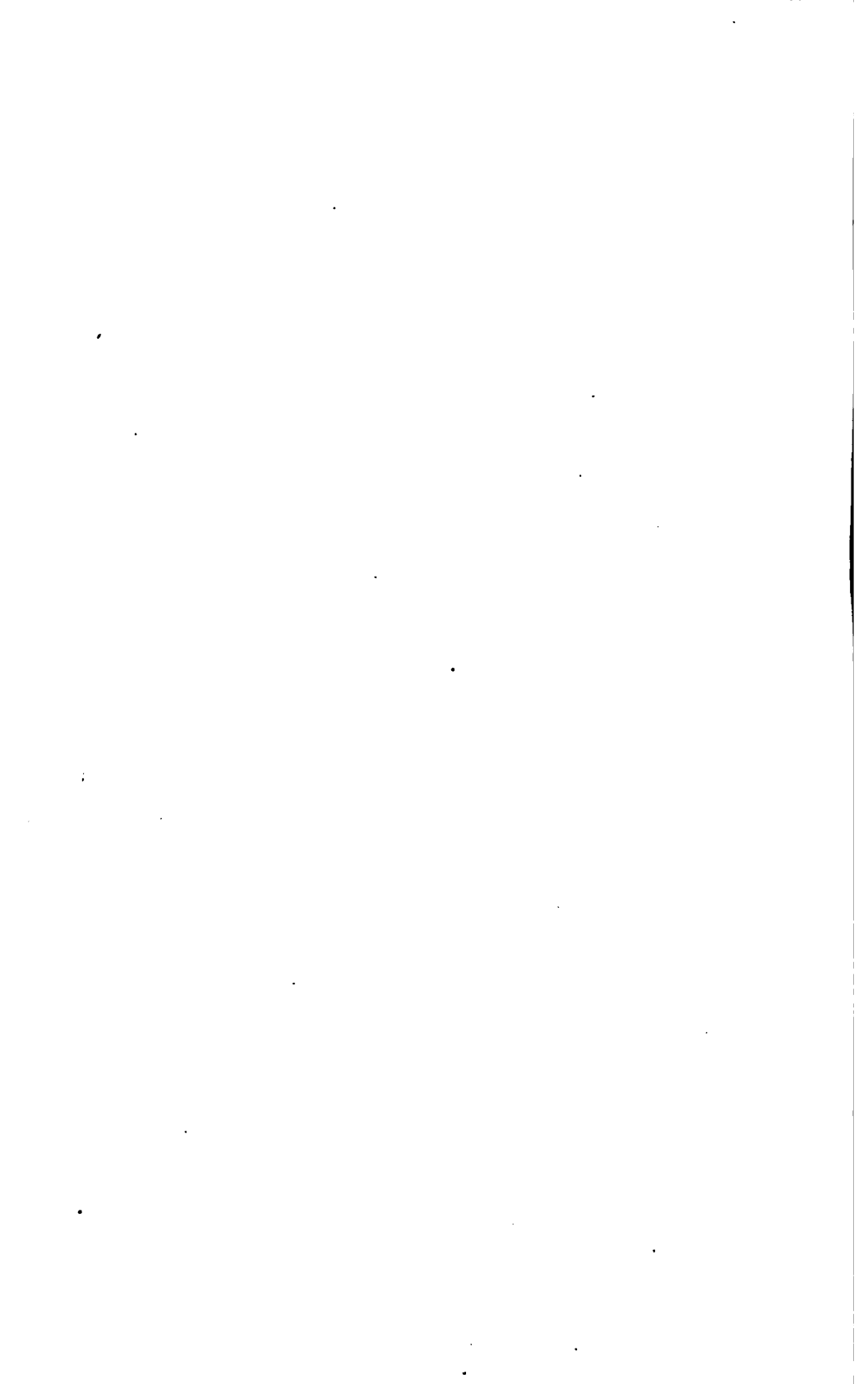
but that it was desired to widen the channel, which is rather crooked, by taking off a portion of the bar extending out from Long Point. This could be easily accomplished with an expenditure of about \$2,000, giving a low-water depth of 10 feet over a channel width twice as wide as that at present in use.

It was stated that about 5,000 tons of coal are landed here every year and the total commerce amounts to perhaps \$25,000.

Very respectfully, your obedient servant,

THOS. L. CASEY,
Captain Engineers.

Maj. W. R. LIVERMORE,
Corps of Engineers, U. S. A.



APPENDIX D.

IMPROVEMENT OF CONNECTICUT RIVER, MASSACHUSETTS AND CONNECTICUT, AND OF RIVERS AND HARBORS ON LONG ISLAND SOUND, CONNECTICUT, AND NEW YORK.

REPORT OF COL. D. C. HOUSTON, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1889, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

- | | |
|--|---|
| 1. Thames River, Connecticut. | 12. Five Mile River Harbor, Connecticut. |
| 2. New London Harbor, Connecticut. | 13. Stamford Harbor, Connecticut. |
| 3. Connecticut River, Massachusetts and Connecticut. | 14. Port Chester Harbor, New York. |
| 4. Clinton Harbor, Connecticut. | 15. Echo Harbor, New Rochelle, New York. |
| 5. New Haven Harbor, Connecticut. | 16. New Rochelle Harbor, New York. |
| 6. Breakwater at New Haven, Connecticut. | 17. East Chester Creek, New York. |
| 7. Milford Harbor, Connecticut. | 18. Greenport Harbor, New York. |
| 8. Housatonic River, Connecticut. | 19. Glen Cove Harbor, New York. |
| 9. Bridgeport Harbor, Connecticut. | 20. Flushing Bay, New York. |
| 10. Black Rock Harbor, Connecticut. | 21. Removing sunken vessels, or craft, obstructing or endangering navigation. |
| 11. Norwalk Harbor, Connecticut. | |

EXAMINATIONS.

- | | |
|--|--|
| 22. Fort Pond Harbor, Montauk, New York. | 24. New London Harbor, Connecticut. |
| 23. Black Rock Harbor, for breakwater to Penfield Reef and south from Fairweather Island, Connecticut. | 25. Mystic River, Connecticut. |
| | 26. Port Jefferson Inlet, Long Island, New York. |

ENGINEER OFFICE, U. S. ARMY,
New York, July 12, 1889.

GENERAL: I have the honor to transmit herewith my annual reports upon the river and harbor works in my charge for the fiscal year ending June 30, 1889.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Colonel of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

D 1.

IMPROVEMENT OF THAMES RIVER, CONNECTICUT.

This river is formed by the confluence of the Yantic and Shetucket rivers at Norwich, Conn., and extends southward as a tidal stream 15 miles to Long Island Sound. For 11 miles above its mouth the channel is from 13 to 80 feet deep, averaging over 30 feet for the first 4 miles. For 3 miles below Norwich the available depth in 1829 was but 6 feet at mean low water, where now there is over 10 feet. The work of improvement has been confined to a stretch of $3\frac{1}{2}$ miles below Norwich. Histories of the improvements may be found in the Annual Reports of the Chief of Engineers, 1873, page 981, and 1879, Part I, page 331.

PROJECTS FOR IMPROVEMENT.

Prior to 1830 various attempts had been made by private parties or corporations to deepen the channel of this river near Norwich, the first ones were by excavation only, but subsequently stone piers were constructed perpendicular to the channel at shoal spots.

By act of March 2, 1829, \$150 were appropriated "for making a survey of the river Thames with a view to improve the navigation of the same, and the cost of such improvement."

The survey was made in 1829 by Capt. Hartman Bache, Corps of Engineers. At that time there were four old piers standing. In his report of the survey, dated February 20, 1830, and printed in House of Representatives, War Department Document No. 125, Twenty-first Congress, first session, Captain Bache submitted a project for making a channel 60 feet wide, to be either 12 or 14 feet deep at high water (9 or 11 feet at low water) by excavation, by rebuilding one of the existing piers, by adding to the other three wings extending up and down stream, converting them into T walls, and by building ten new piers extending down-stream in curves. The piers were to be of riprap 3 feet wide on top, with side slopes of 45 degrees; they were to be built to heights of from $1\frac{1}{2}$ to $3\frac{1}{2}$ feet above highest tide, those furthest upstream being the highest. The piers were estimated to require 43,436 cubic yards of riprap, and the excavation for the 12-foot channel was placed at 27,895 cubic yards, for the 14-foot channel at 69,251 cubic yards. The cost of the whole work was estimated at \$72,650. The project was adopted, and under appropriations of 1836, 1837, and 1838—\$40,000 in all—the piers were built nearly as designed, with the exception of two of the new piers and one wing-wall, which were not constructed; considerable dredging was done, but no complete record of amount appears to have been kept. At this time \$500 were annually expended in river improvements by the Merchants' Bank of Norwich, Conn., being a bonus required by their charter. Work was stopped in 1839 by exhaustion of appropriations.

In 1866 a petition of citizens of Norwich, asking for an appropriation for removing obstructions in the river Thames, was referred to the Chief of Engineers, and returned by him to the Secretary of War, with a report describing the work done upon the river, recommending no further work on the piers until their efficiency could be investigated satisfactorily, and stating:

In conclusion it is considered that should the sum of \$8,000 be appropriated for the improvement of this river, to be applied during the next fiscal year, all will be accomplished that can be justifiably undertaken until a commission decides upon other efficacious methods or systems of improvement.

June 23, 1866, an appropriation of \$10,000 was made for improving the river, under which a survey was made, and a project for dredging to obtain a depth of 11 feet at low water (14 feet at high water) was adopted.

Under this and succeeding appropriations, up to 1878, this channel was dredged, and, as far as possible, maintained with a width of 100 feet. March 3, 1879, \$12,000 was appropriated "for the improvement of the Thames River to secure a 14-foot channel," and, in accordance therewith, the project was modified to provide for a channel of that depth at low water.

In 1882, upon recommendation of Major Barlow, approved by the Board of Engineers, the project was further modified by providing for the construction of five dikes, or training-walls, along the outer sides of the channel curves, with the addition of low walls on the inner sides should they be found necessary, the width of water-way between them increasing from 300 feet (about the full width of the river) at Thamesville, 1 mile below Norwich, to 480 feet at the lower dike.

The object of the training-walls was to utilize the effect of the tides in keeping the channel open; they were to be built up to high-water level, and to have an aggregate length of 13,800 feet. In the same year the projected width of channel was increased to 200 feet. The improvement was designed to extend over the first $3\frac{1}{2}$ miles below Norwich, and the estimated cost was—

For the five dikes, or training-walls	\$92,800
For dredging 200 feet wide and 14 feet deep	125,280
Total	208,080

In May, 1888, in response to a letter from the Hon. Charles Russell, M. C., to the Secretary of War, asking the "approximate cost of completing the 16 feet deep channel to Allyn's Point, and the 14 feet deep channel to Norwich," estimates for the same were submitted as follows:

For securing by dredging a 16-foot channel up to Allyn's Point	\$24,000
For securing by dredging a 14-foot channel from Allyn's Point to the end of the existing improvement	16,200

By act of Congress of August 11, 1888, an appropriation of \$50,000 was made for continuing the improvement of Thames River, with a clause authorizing its expenditure "at any point between Norwich and New London."

The project was therefore extended to include the above described work, and, as now adopted, it consists in making and maintaining, by dredging and by a system of training-walls, a channel 200 feet wide from New London to Norwich, having 16 feet depth at low water up to Allyn's Point, about 5 miles below Norwich, and 14 feet from Allyn's Point to Norwich.

The additional cost of this extension of project was estimated at about \$40,000, which should be added to the estimated amount required for completion of the previous project, making the present estimate for completion \$95,600; the estimated cost for annual maintenance should also be increased to \$8,000.

Under this project up to July 1, 1888, 170,922 cubic yards of sand had been dredged from the channel; the three dikes furthest down-stream had been built and a fourth one built to about three quarters its contemplated length.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1889.

Under a contract entered into June 12, 1888, with the Hartford Dredging Company, of Hartford, Conn., for dredging in the river at the rate of 19 cents per cubic yard, the middle ground at Norwich was removed to a depth of 9 feet below mean low water, with a channel on the east side of 250 feet in width made 12 feet deep.

Work under this contract was begun July 16 and completed September 25, 1888; 32,835 cubic yards of sand, stones, etc., were removed and deposited behind the dikes in the river, in accordance with the terms of the contract; 2,129 cubic yards additional were dredged from outside the specified limits and were not paid for.

Under the appropriation of \$50,000 made by act of Congress of August 11, 1888, after due advertisement proposals were opened December 13, 1888, for dredging in the river at and below Allyn's Point, and for dredging in the river above Allyn's Point.

A contract for the first named work was entered into with Elijah Brainard of New York City, under date of January 9, 1889, and at the rate of 18.9 cents per cubic yard. Work under this contract was begun January 9, 1889, and completed June 11, 1889; 84,890 cubic yards of sand and mud being removed. A channel 200 feet wide and 16 feet deep at mean low water was made through the cross-over shoal at "Bartlett's" about 8 miles below Norwich, and the bends at the entrance of this channel were reduced; 68,991 cubic yards were dredged at this shoal. At Allyn's Point the channel was widened on the east side by from 100 to 200 feet, principally so that vessels wishing to discharge at the wharves should be able to lie at anchor without blocking the main channel; the depth made was 16 feet below mean low water, and the amount of sand and mud taken out was 15,899 cubic yards.

A contract for dredging above Allyn's Point was entered into February 4, 1888, with the Hartford Dredging Company, of Hartford, Conn., at the rate of 15.7 cents per cubic yard. Work under this contract was begun April 23, and up to the close of the fiscal year 33,547 cubic yards had been dredged, making 12 feet depth over the "Haycocks" Shoal and over the shoal below the Norwich and Winchester Railroad Wharf; the contract is in progress.

Part of the material was deposited behind dikes and part in a blind channel near the west shore.

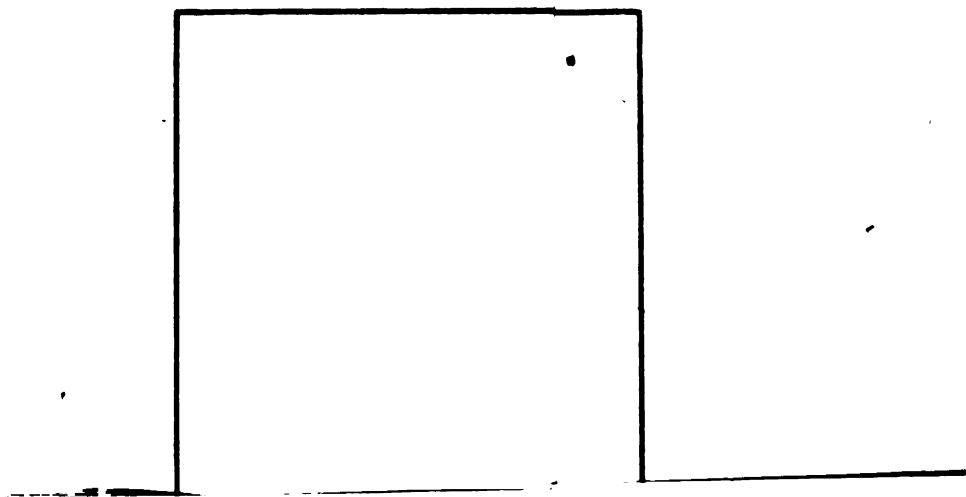
An examination of the Middle Ground at Norwich, made in April, 1889, showed that it had shoaled slightly at the upper end during winter and spring, but otherwise had retained the depth made last year. The freshets of last winter and spring were not as high as usual.

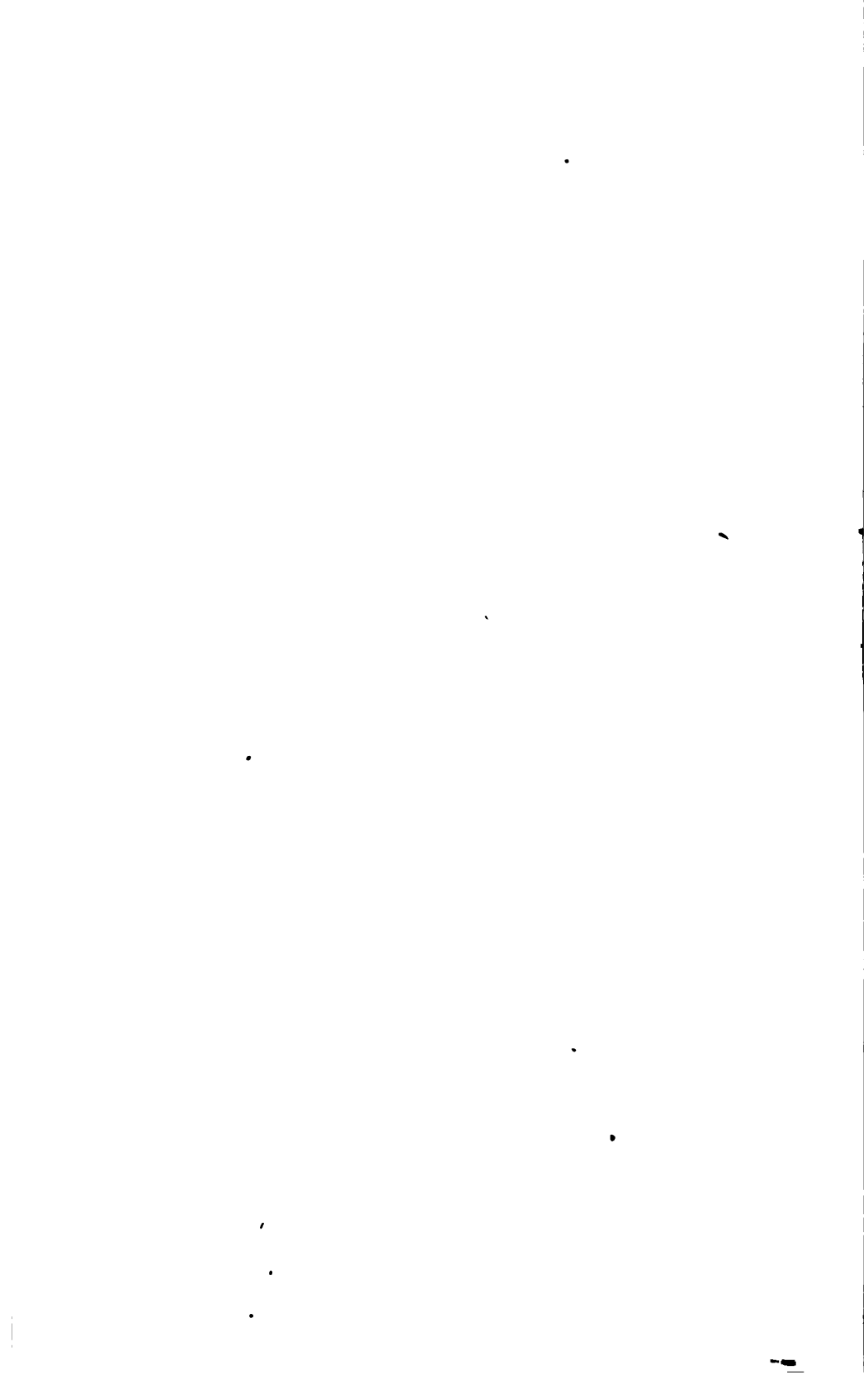
PRESENT CONDITION OF THE IMPROVEMENT.

Of the five dikes provided for in the project, the four furthestest downstream have been constructed at cost, as follows:

Location.	Date of completion.	Length.	Number of tons of rip-rap (exclusive of repairs).	Cost, exclusive of supervision.
		<i>Feet.</i>		
Mohogan, 3½ miles below Norwich	1888	2, 968	(*)	\$23, 698. 00
Trading Cow, 2½ miles below Norwich	1882	2, 370	17, 207	21, 113. 05
Long Rock, 2 miles below Norwich	1885	2, 800	11, 945	12, 781. 15
Rolling Mills, 1½ miles below Norwich	1887	2, 092	18, 531	18, 772. 58

* Pile-dike.





The Rolling-Mill Dike, originally designed to be 4,350 feet long, is now 3,093 feet long, with a gap of 390 feet at the "Sand Pier," and extends to about 250 feet south of the lower rolling-mill embankment. The project contemplated extending it about 600 feet north of the embankment; since its adoption the Lower Rolling-Mill Company has dredged a channel towards shore on the north side of the embankment, which is now used as a landing. It would be necessary to leave an opening for this channel, and probably it will be found expedient not to extend the dike above the embankment. The upper dike, one-half mile below Norwich, designed to be 1,050 feet long, has not been begun. Three of the dikes have settled from a foot to a foot and a half in places and will need repairs.

The low-water depth in the channel from New London to Allyn's Point is not less than 16 feet, with width of 200 feet or over; from Allyn's Point to Walden's Island the depth is 14 feet, and from Walden's Island to Norwich the least depth is 11 feet; above Walden's Island the width is from 75 to 150 feet.

PROPOSED OPERATIONS.

Under the contract in progress the channels between Walden's Island and Norwich will be made 100 feet wide and 12 feet deep; the channel at Walden's Island will be made 14 feet deep, and the sharp bend at Long Reach, about 5 miles below Norwich, will be reduced.

With the remainder of the present appropriation it is proposed to repair the dikes as far as immediately necessary.

Future appropriations will be applied to completing the dikes and to making and maintaining a channel 200 feet wide, to be 16 feet deep up to Allyn's Point, and thence to Norwich to be 14 feet deep, as provided in the project.

Appropriations for the improvement of Thames River have been made as follows:

Application.	Date.	Amount.
Removal of obstructions placed during war of 1812	Mar. 3, 1821	\$150
Survey	Mar. 2, 1829	150
Piers and dredging	July 4, 1836	10,000
Do	Mar. 3, 1837	20,000
Do	July 7, 1838	10,000
Dredging and survey	June 23, 1866	10,000
Dredging	Mar. 3, 1867	72,000
Do	Mar. 3, 1871	15,000
Do	June 10, 1872	10,000
Do	June 18, 1878	10,000
Do	Mar. 3, 1879	12,000
Do	June 14, 1880	22,500
Dredging and training-walls	Mar. 3, 1881	80,000
Training-walls	Aug. 2, 1882	* 35,000
Do	July 5, 1884	* 25,000
Training-walls and dredging	Aug. 5, 1886	* 22,500
Repair of training-walls and dredging	Aug. 11, 1888	* 50,000
Total		354,300

* Appropriated for present project: These with \$20,000 from previous appropriation (see Annual Report for 1882, Part 1, page 603) make total of \$152,500 for present project.

The Thames River is in the collection district of New London. The nearest light-house is at the mouth of the river, on the west shore. Forts Trumbull and Griswold overlook the mouth of the river from either shore.

Money statement.

July 1, 1888, amount available.....	\$1,350.89
Amount appropriated by act of August 11, 1888	50,000.00
	<hr/> 51,350.89
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$20,768.64
July 1, 1889, outstanding liabilities.....	2,611.13
July 1, 1889, amount covered by existing contracts.....	7,850.00
	<hr/> 31,229.77
July 1, 1889, balance available.....	<hr/> 20,121.12
<hr/>	
{ Amount (estimated) required for completion of existing project.....	95,600.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	95,600.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

*Abstract of proposals for dredging in Thames River above Allyn's Point, Connecticut, opened
December 13, 1888, by Col. D. C. Houston, Corps of Engineers.*

No.	Name and address of bidder.	Rate per cubic yard (80,000 cubic yards).	Amount of bid.
		<i>Cents.</i>	
1	Elijah Brainard, New York City	21	\$16,800
*2	Hartford Dredging Company, Hartford, Conn	15.7	12,500
3	John H. Fenner, Jersey City, N. J.	18	14,400
4	Morris & Cummings Dredging Company, New York City	23	18,400

* Lowest bid; entered into contract February 4, 1889; in progress.

NOTE.—Amount available for contract work, \$22,000.

*Abstract of proposals for dredging in Thames River below Allyn's Point, Connecticut, opened
December 13, 1888, by Col. D. C. Houston, Corps of Engineers.*

No.	Name and address of bidder.	Rate per cubic yard (80,000 cubic yards).	Amount of bid.
		<i>Cents.</i>	
*1	Elijah Brainard, New York City	18.9	\$15,120
2	P. Sanford Ross, Jersey City, N. J.	25	20,000
3	Hartford Dredging Company, Hartford, Conn	23	18,400
4	Morris & Cummings Dredging Company, New York City	27	22,000

* Lowest bid; entered into contract January 3, 1889; contract completed June 11, 1889.

NOTE.—Amount available for contract work, \$22,000.

COMMERCIAL STATISTICS FOR THE CALANDER YEAR 1888.

From the best obtainable estimates the amount of freight received in this river is about 255,000 tons, valued at \$2,350,000. By far the larger part of this is coal, the rest is iron, building materials, dye-woods, and general merchandise.

It is carried in vessels drawing from 4½ to 16 feet of water.

D 2.

IMPROVEMENT OF NEW LONDON HARBOR, CONNECTICUT.

New London Harbor is that part of the Thames River which lies in front of the city of New London, extending from Winthrop's Point to Long Island Sound, a distance of about 3 miles. It has good anchorage ground and a channel from 30 to 50 feet deep and a quarter of a mile wide, extending up to Winthrop's Point. It is one of the best harbors on the Atlantic coast.

PROJECT FOR IMPROVEMENT.

In the Annual Report for 1878 upon the improvement of Thames River (see Annual Report of the Chief of Engineers for 1878, Part 1, page 397), shortly after the completion of the New London Northern Railroad Wharf, a petition of certain citizens of New London and Norwich was presented, asking that the United States undertake the removal of a shoal east of that wharf. The desired work was estimated to cost \$6,800, and it was recommended that it be included in the general project for the improvement of the Thames River. The estimate was as follows:

To remove the shoal and bowlders to a depth of 16 feet at mean low water will require the excavation of 125 cubic yards of bowlders, at \$5 per yard.....	\$625
37,000 cubic yards of gravel and mud, at 15 cents per cubic yard	5,550
Add for contingencies	625
Total	6,800

This shoal extended from the shore out about as far as the end of the wharf. The part whose removal was contemplated was that part lying south of a line running east from a point on the railroad wharf 500 feet from its outer end.

The river and harbor act approved June 14, 1880, appropriated "for the improvement of the Thames River, of which sum \$2,500 shall be expended in the removal of rocks and sand from New London Harbor, \$25,000."

In 1881 and subsequently appropriations were made for improving New London Harbor.

The first work under this project, so inaugurated, was done in 1880. It was found that the presence of bowlders made the dredging much more expensive than had been counted on, and in the Annual Report for 1881 (see Annual Report of the Chief of Engineers for 1881, Part 1, page 586) a new estimate was submitted, placing the cost from the beginning at \$24,000.

In 1882 the project was modified so that the area to be dredged should be that part of the shoal lying southwest of a line running about southeast from a point on the wharf 600 feet from its outer end; the object of this modification was to avoid as far as possible the large bowlders that were found near the crest of the shoal, and to keep the cost of the work within the last estimate, while affording no less accommodation to vessels using the wharf. The depth over this part of the shoal was from 5 to 15 feet at mean low water.

Nineteen thousand eight hundred dollars have been appropriated for this work; 22,902 cubic yards of sand and stones and 564 cubic yards of bowlders have been removed.

The proportion of bowlders to mud and gravel in the original estimate was about 1 to 300; the proportion actually found has been about 1 to 41. The actual cost of dredging mud and gravel has averaged 54½ cents per cubic yard, and of removing bowlders \$8.51 per cubic yard. The bowlders have ranged in size from one-fourth cubic yard to 5 cubic yards, many of them having to be blasted.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1889.

No work was done, the project being substantially completed.

Appropriations for improving New London Harbor have been made as follows, viz :

Application.	Date.	Amount.
Dredging shoal east of railroad wharf	June 14, 1889	\$2,500
Do.....	March 3, 1881	4,000
Do.....	Aug. 2, 1883	9,000
Do.....	July 5, 1884	2,000
Do.....	Aug. 5, 1886	2,000
Total		19,500

* Part of appropriation for Thames River improvement.

New London, the port of entry for the collection district of New London, is situated on the west bank of the Thames River, about 2½ miles from Long Island Sound. The harbor is the mouth of the Thames River.

New London light-house is located at the entrance to the harbor, on the west shore. Forts Trumbull and Griswold command the harbor from either side.

Money statement.

July 1, 1888, amount available	\$201.39
July 1, 1889, balance available	201.39

D 3.

IMPROVEMENT OF THE CONNECTICUT RIVER, MASSACHUSETTS AND CONNECTICUT.

This river rises in the northern part of New Hampshire, flows in a general southerly course between the States of New Hampshire and Vermont, crosses the States of Massachusetts and Connecticut, and empties into Long Island Sound at Saybrook Point, Connecticut. It is divided naturally into two parts, Hartford, Conn., at the head of navigation, being the point of division, and appropriations by Congress have generally specified in which part the money appropriated was to be expended.

The divisions are as follows :

1. *Above Hartford, Connecticut.*—Embracing a length of about 66 miles, from Hartford, Conn., to Miller's Falls, Mass.

2. *Below Hartford, Connecticut.*—Embracing a length of about 50 miles from Hartford to Long Island Sound.

By the river and harbor act of 1882 an examination or survey of the Connecticut River from Bellows Falls, Vt., to Pittsburgh, N. H., was authorized. Bellows Falls is about 105 miles above Hartford, and Pitts-

burgh is 180 miles above Bellows Falls. A preliminary examination was made, the report on which, printed in the Annual Report of the Chief of Engineers for 1884, Part 1, page 659, recommended no survey and proposed no plan of improvement.

(1) ABOVE HARTFORD, CONNECTICUT.

Miller's Falls, Mass., is at the head of possible navigation of the Connecticut River. From this point down to Holyoke, Mass., a distance of about 32 miles, the river is susceptible of improvement, but it can not be used by vessels now on account of a dam and falls at Holyoke, which entirely obstruct navigation. The lockage required to lift boats from the lower to the upper levels at Holyoke is about 60 feet. From Holyoke, Mass., to Enfield Falls, Conn., a distance of 18 miles, there is a fair channel, 4 to 5 feet deep at low water, which could be made 8 feet deep. Enfield Falls, or Rapids, cover a stretch of river about 5 miles long, having a fall of about 32 feet at low water. The bed is rocky and very uneven, and the slope is not uniform, but consists of a succession of long, shallow reaches separated by rapids.

From the foot of Enfield Falls to Hartford, a distance of 11 miles, the river has a broad, sandy bed with a depth of 2 to 5 feet at low water. Under a charter from the State of Connecticut, granted in May, 1824, the Connecticut River Company has constructed a canal, with locks, around Enfield Falls. The locks are 80 feet long, 18 feet wide, and 4½ feet deep. The canal is chiefly used for water-power; the company collects toll from vessels using it.

Following is a list of places in this part of the river where work has been done by the United States, with distances above the wagon bridge at Hartford:

	Miles.
Barber's Landing.....	4
Farmington River.....	5
Strong's Island.....	6½
Scantic River.....	7½

PROJECTS FOR IMPROVEMENT.

No general project for the improvement of this part of river is on record as approved and adopted. All the work done has been under special projects for expenditure of the several appropriations. It consists of dredging at Barber's Landing in 1873, and construction of dikes, or wing-dams, at Scantic River, Strong's Island, and Farmington River in 1871, at Farmington River and Barber's Landing in 1878, and again in 1880 and 1881.

Plans and estimates for a larger canal around Enfield Falls were submitted in 1878, and modified in 1880. (See Annual Report of the Chief of Engineers for 1881, Part 1, p. 566.) They proposed a canal on the east bank of the river, extending from above Enfield Falls down to the mouth of the Hockanum River, opposite and just below Hartford, as the best means of gaining an available depth of 8 feet from Hartford to and around the falls.

The canal levels were to be 10 feet deep at low water, and 120 feet wide at the water-line; the locks 200 feet long, 55 feet wide, with 8 feet depth over the miter-sills at low water. The cost of the work was estimated at \$1,332,805. It was considered not advisable to begin construction with a less sum than \$450,000.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1888.

No work was done. The available money is insufficient to begin any general improvement in this part of the river.

PRESENT CONDITION OF IMPROVEMENT.

The wing-dams are all in fair condition; they are as follows:

One at Scantic River, one at Strong's Island, one at the mouth of Farmington River, two nearly opposite the mouth of Farmington River, and two on the east bank, opposite Barber's Landing.

The available channel depth from Hartford to Scantic River is about 2 feet at ordinary summer stage of water; this part of the river is navigable for freighting only when in freshet. No work has been done above Scantic River; the depth from there up to the foot of Enfield Falls is greater than from there down to Hartford.

PROPOSED OPERATIONS.

No work in the river above Hartford is contemplated during the ensuing year. Should any injury to the wing-dams occur, the money available will be sufficient for repairs.

Appropriations for improving the Connecticut River *above* Hartford have been made as follows, viz:

Application.	Date.	Amount.
Dams at Scantic River, Strong's Island, Farmington River, and Barber's Landing; repairs of dams; dredging at Barber's Landing; surveys.	July 11, 1870	\$20,000
	March 2, 1871	20,000
	June 10, 1872	25,000
	March 2, 1873	20,000
	June 14, 1880	15,000
Total.....		100,000

Of these amounts, the following balance is yet unexpended:

From appropriation of June 14, 1880, for "improving Connecticut River between Hartford and Holyoke," \$9,133.20.

Money statement.

July 1, 1888, amount available.....	\$9,133.20
July 1, 1889, balance available	9,133.20

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1888.

Receipts by water.

Articles.	Tons.	Value.
Coal.....	3,500	\$20,000
Paper and paper stock	200	5,000
Total.....	3,700	25,000

Vessels employed in this traffic.	Tonnage.	Draught.
2 steam-tugs.....	Tons. 30	Feet. 4
4 scows.....	300	3

In its present condition this part of the river is navigable only during freshets.

(2) BELOW HARTFORD, CONNECTICUT.

The Connecticut River below Hartford is a large stream, for the first 21 miles flowing in a winding course, mostly through alluvial meadows, which are overflowed at high water, and which consist of a light, sandy soil, easily undermined. For the remaining 29 miles to Long Island Sound, at Saybrook Point, the course is straighter, the banks more permanent and generally harder.

A gauge has been established at Hartford, whose zero is the lowest stage that the water is known to have reached from natural causes; closing the gates at the Holyoke Dam in time of drought has caused the water to fall lower. The usual low-water stage of the river in summer is about 1 foot on this gauge; spring freshets ordinarily rise to 20 feet; the highest recorded stage of water is 29 feet.

The average tide at Saybrook is $3\frac{1}{2}$ feet; at Hartford it is about 1 foot, though when the water stands above 5 feet on the Hartford gauge the tide there is not perceptible. The slope of the river from Hartford to Saybrook averages .0458 foot per mile. The bed of the river, through the alluvial meadows within 10 miles of Hartford, is constantly changing, from the undermining of the banks. It is said that in places it has changed its position a half mile. The bars in this part of the river, after being dredged, form again during freshets and ice-jams so that some of them require dredging annually; others less frequently. This part of the river was worked upon by corporations and private parties at various times between 1800 and 1870. Several small stone piers, to deepen the channel at shoal places, were built in this way. Some of these are covered by new banks, the channel has shifted to the opposite side of others, and others still have been dredged out, because they had come to be obstructions. The depth sought by these works was 6 feet at low water.

The following list gives the names of the several places on the river below Hartford where work has been done by the United States, with their distances by course of channel below the Hartford wagon bridge:

Locality.	Miles.	Locality.	Miles.
Hartford Bar.....	1 $\frac{1}{2}$	Pistol Point Bar.....	15
Clay Banks bar.....	2 $\frac{1}{2}$	Mouse Island Bar.....	20 $\frac{1}{2}$
Praet's Ferry, or Naubuc Bar.....	5 $\frac{1}{2}$	Haddam Island Bar.....	30
Press Barn Bar.....	6 $\frac{1}{2}$	Chester Rock.....	38
Glastonbury Bar.....	9 $\frac{1}{2}$	Calves Island Bar.....	44 $\frac{1}{2}$
Dividend Bar.....	12	Saybrook Bar (at mouth).....	50

PROJECTS FOR IMPROVEMENT.

By act of July 4, 1836, Congress appropriated \$20,000 "for improving the harbor at Saybrook, by removing the bar at the mouth of the Connecticut River." Under this appropriation a survey was made by Capt. W. H. Swift, U. S. Engineer Corps. In his report on this survey, dated January 31, 1837, and printed in House Ex. Doc. No. 252, Twenty-fifth Congress, Captain Swift submitted a project for deepening the west channel over Saybrook Bar, dredging a cut 500 feet wide and 12 feet deep at mean low water, at an estimated cost of \$54,380.50; the estimated cost per cubic yard for dredging and dumping was 25 cents. The available depth over the bar before dredging was 7 feet at mean low water. Captain Swift's project was approved, and work was begun in May, 1838, under contract with Randall, Haskell & Holmes, at the

rate of 62½ cents per cubic yard, measured in scows; dredging was continued until the fall of 1840, when the appropriation was exhausted; 26,984 cubic yards of sand and stones had been removed, making a channel 1,500 feet long, 50 feet wide, and from 11 to 12 feet deep. This channel was nearly destroyed by storms and freshets in the following winter and spring. March 1, 1843, \$3,471.57 was appropriated to pay a balance due the contractors.

No further work was done upon the river until 1867. By act of Congress, approved March 2, 1867, a survey of the river was ordered, which was made in the following season, and which embraced all the principal bars and obstructions between Hartford and Long Island Sound. With the report on this survey, dated January 11, 1868, and printed on page 754 *et seq.*, of the Annual Report of the Chief of Engineers for 1868, was presented a project for improving this part of the river; it proposed dredging at Hartford, Clay Banks, Pratt's Ferry, Glastonbury, and Pistol Point, to make channels 8 feet deep at low water and 100 feet wide, dredging at Saybrook Bar to make a channel 8½ feet deep and 200 feet wide, piling for shore protection at Hartford and Wethersfield, and the removal of Chester Rock, at a total estimated cost of \$70,000; an estimate of \$10,000 for annual maintenance was submitted. All the dredging done up to 1880 was, in accordance with this project, extended to make 9 to 9½ feet depth, instead of 8 feet, and also to include Press Barn, Dividend, and Mouse Island bars; the piling at Hartford was built in 1871, and the removal of Chester Rock was begun in the same year, but abandoned by the contractor soon after beginning.

January 22, 1873, a project for building three jetties at Saybrook and for dredging was approved by the Secretary of War; the jetties were to be of a double row of piles 20 feet apart, filled with stone to a height of 8 feet above low water; the dredging was to be 9 feet deep and 400 feet wide. The estimated cost was:

Dredging.....	\$17,850
Jetties.....	318,760
Total.....	336,610

Before work on the jetties was begun the plan of construction was modified to one for building them of riprap stone, triangular cross-section, rising to level of highest water, *i. e.*, about 5 feet above mean low water, this plan being much more economical than the previous one.

The jetties were begun in 1873, and two of them were completed in 1881. The third has not been built, and may not be needed; the west jetty has since been extended, and both have been repaired and strengthened.

In 1880 a project was adopted for permanent works of improvement at six of the worst bars (see Annual Report of the Chief of Engineers for 1880, Part I, page 396 *et seq.*).

This project provided for riprap wing doors, mattress shore protection, and rectification of the banks at the following places, *viz*:

Locality.	Amount.	Locality.	Amount.
Hartford Bar.....	\$33,464	Glastonbury Bar.....	\$114,823
Clay Banks Bar.....	69,116	Dividend Bar.....	7,110
Pratt's Ferry or Naubuc Bar.....	64,785		
Press Barn Bar.....	41,140	Total.....	336,487

With dredging, to make and maintain a permanent channel. The project did not provide for extension and repair of the Saybrook jetties, nor did the estimate include any amount for annual dredging to maintain channels, nor for dredging between the jetties at Saybrook, nor for any work whatever at Pistol Point, Mouse Island, Haddam Island, and Calves Island bars, where dredging has since been required; all of these have consumed a large part of the appropriations made since.

Under this project, extended as above up to the close of the last fiscal year, a training-wall of riprap, 3,689 feet long, had been built at Hartford Bar (instead of the proposed wing dam), and a riprap wing-dam 5,300 feet long had been built at Glastonbury Bar, both to the height of 3 feet above low water; part of the Hartford training-wall was subsequently built to 4 feet above low water; the west jetty at Saybrook had been extended to the 16-foot curve, the east jetty to the 12-foot curve, and a channel 120 feet wide and 12 feet deep at mean low water had been dredged between them, besides maintaining the required depth in the upper half of this part of the river by annual dredging at a cost of from \$5,000 to \$10,000 each year.

In 1887 it had become evident that the proposed plan of permanent improvement would not materially reduce the amount of dredging annually required, and that no effectual substitute could be recommended which would not be very expensive; and in December, 1887, a new project was adopted, under which future operations were to be confined to completing the jetties at the mouth of the river to a height of 5 feet above high water, with a top width of 6 feet, widening the channel between the jetties to 400 feet width with a depth of 12 feet at mean low water, and annual dredging to maintain the channel from Hartford to Long Island Sound at an estimated cost, as follows:

For completing jetties.....	\$60,000
For dredging between jetties	20,000
	<hr/>
	80,000

For average annual maintenance of channel from Hartford to Long Island Sound \$10,000.

The reasons for this change of project are fully given in a letter printed in the annual report of the Chief of Engineers for 1888, Part I, pages 536-538.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1889.

At the close of the last fiscal year dredging was in progress under an open market transaction with Mr. C. C. Goodrich, of Hartford, Conn., the rate of payment being 10 cents per cubic yard of material dredged from the river, and for work between the jetties at the mouth of the river a rate per day equal to the average per diem earning in the river. Under this transaction 15,130 cubic yards had been dredged from bars in the river up to July 1, 1888, making depths of 9 feet at low water. Work was continued until December 8, 1888, and channels of the required depth were made through all the shoals in the river, and the channel between the jetties at the river's mouth was widened to 130 feet, with depth of 12 feet at low tide.

The following table shows the amount of work done under this arrangement, both before and after July 1, 1888.

	Before July 1, 1888.	Since July 1, 1888.*
	<i>Cu. yards.</i>	<i>Cu. yards.</i>
Hartford Bar	10, 895	13, 360
Clay Banks Bar	3, 310	5, 404
Press Barn Bar and Crow Point		6, 834
Glastonbury Bar	825	8, 144
Dividend Bar		7, 306
Pistol Point Bar		6, 349
Saybrook Bar		28, 782
Total	15, 130	78, 275

* 50½ days worked.

By act of Congress of August 11, 1888, \$10,000 was appropriated for continuing the improvement of the river; the amount estimated for annual maintenance of depth.

The advantageous rates of the previous year's open market transaction could not be renewed in 1889, and as it was impracticable to specify with any accuracy and in advance what work would be required, proposals were advertised for and opened March 13, 1889, for hire of dredging plant by the hour, and a contract dated April 23, 1889, was entered into with J. H. Fenner, of Jersey City, N. J., to furnish the required plant at the rate of \$8.45 per working hour. Under this contract work was begun May 20, and up to the close of the fiscal year the plant had worked 372½ hours, dredging 22,233 cubic yards, as follows:

	<i>Cubic yards.</i>
From Hartford Bar	13, 967
From Glastonbury Bar	4, 112
From Dividend Bar	4, 134

The total amount dredged from the river, including Saybrook Bar, during the past fiscal year, is 98,511 cubic yards.

PRESENT CONDITION OF IMPROVEMENT.

At the close of the fiscal year dredging was in progress upon the shoals which had formed during the winter and spring. These shoals were in rather worse than an average condition, due to the long and unusual freshets of the late fall and winter; the spring freshets of 1889 were not as high as ordinary. Under the contract now in force the depth of 9 feet has been partly restored on the bars at Hartford, Glastonbury, and Dividend.

The channel between the Saybrook jetties is as left last fall, 12 feet deep and 130 feet wide.

The Hartford Dike is in good condition; the Glastonbury Dike, built on a convex bank, is now nearly covered by the advance of the bank.

Both jetties at Saybrook are in fair condition. They should be built up to the dimensions provided for in the project to make them permanent.

The length of the dikes and jetties is as follows:

	<i>Feet.</i>
Hartford Dike	3, 968
Glastonbury Dike	5, 300
Saybrook:	
West jetty	2, 560
East jetty	2, 316

PROPOSED OPERATIONS.

With the funds available, the 9-foot depth on the bars between Hartford and Long Island Sound will be restored.

The object of first importance will always be the annual maintenance of this 9-foot depth; so much of future appropriations as is not needed for this purpose should be applied to enlarging the Saybrook jetties and to widening the channel between them, as provided in the project.

About \$3,700 was expended on the channel at Saybrook last year.

The appropriation of August 11, 1888, being applied to annual maintenance of channels, does not reduce the amount of estimate for completion.

Appropriations for the improvement of the Connecticut River below Hartford have been made as follows:

Application.	Date.	Amount.
Dredging at Saybrook Bar	July 4, 1836	\$20,000.00
Dredging at Saybrook Bar (the unexpended balance of 1836 was re-appropriated).	Mar. 3, 1839	.....
Balance due contractors under previous appropriations	Mar. 1, 1843	3,471.57
Survey	Mar. 2, 1867	3,995.22
Dredging at Pratt's Ferry, Pistol Point, Mouse Island; piling at Hartford.	July 11, 1870	20,000.00
Dredging at Hartford, Clay Banks, Pier I, Pier J, Pratt's Ferry, Glastonbury, Pistol Point, and Chester Rock.	Mar. 3, 1871	25,000.00
Dredging at Pratt's Ferry and Pistol Point; Saybrook jetty	June 10, 1872	40,000.00
Dredging at Hartford, Pratt's Ferry, Glastonbury; Saybrook jetty	Mar. 3, 1873	20,000.00
Dredging at Hartford, Pratt's Ferry, Saybrook; Saybrook jetties	June 23, 1874	20,000.00
Dredging at Hartford, Pratt's Ferry, Glastonbury; Saybrook jetties	Mar. 3, 1875	20,000.00
Dredging at Hartford, Pratt's Ferry, Glastonbury; Saybrook jetties; Salmon River, dredging.	Aug. 14, 1876	20,000.00
Compensation for previous dredging	— —, 1878	4,203.00
Saybrook jetties; survey from Hartford to Rocky Hill	June 18, 1878	80,000.00
Dredging at Hartford, Press Barn, Glastonbury	Mar. 3, 1879	10,000.00
Dredging at Hartford and Glastonbury; Saybrook jetties	June 14, 1880	10,000.00
Dredging at Hartford, Pratt's Ferry, Glastonbury; Glastonbury wing-dam and Saybrook jetties.	Mar. 3, 1881	30,000.00
Dredging at Hartford, Clay Banks, Pratt's Ferry, Press Barn, Glastonbury, Dividend, Pistol Point, and Salmon River; Hartford Dike.	Aug. 2, 1882	45,000.00
Dredging at Hartford, Clay Banks, Pratt's Ferry, Press Barn, Glastonbury, Dividend, Pistol Point, Mouse Island, and between Saybrook jetties; extending west jetty at Saybrook.	July 5, 1884	35,000.00
Dredging at Hartford, Clay Banks, Nanbae, Press Barn, Glastonbury, Dividend, Pistol Point, and Haddam Island; repair of Hartford Dike and Saybrook jetties.	Aug. 5, 1886	26,250.00
Compensation for previous dredging	Mar. 3, 1885	4,745.43
Annual dredging, in progress	Aug. 11, 1888	10,000.00
Total		407,665.32

The Connecticut River is in the collection district of Hartford. By course of river the distance from Holyoke, Mass., to Hartford, Conn., is about 34 miles, and from Hartford to Long Island Sound, about 50 miles. There is a light-house on Saybrook Point, on the west shore of the river, at its mouth, and another at the end of the west jetty, besides which there are three small beacon lights in the lower part of the river which are maintained by the United States.

Fort Trumbull, New London Harbor, Connecticut, about 16 miles east from Saybrook Point, is the nearest work of defense.

Money statement.

July 1, 1888, amount available	\$3,744.37
Amount appropriated by act of August 11, 1888	10,000.00
	13,744.37
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$4,154.52
July 1, 1889, outstanding liabilities	2,336.17
July 1, 1889, amount covered by existing contracts	3,000.00
	9,488.69
July 1, 1889, balance available	4,255.68

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{ Amount (estimated) required for completion of existing project	\$20,000.00
{ Amount (estimated) required for annual maintenance of channel	10,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	90,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of contract for improving Connecticut River, in force during the fiscal year ending June 30, 1889.

Name and address of contractor.	Date of contract.	Subject.	Price per hour.	Remarks.
J. H. Fenner, Jersey City, N. J.	1889. April 23.	Hire of dredging plant ...	\$8.45	Contract in progress.

Abstract of proposals for hire of dredging plant for improving Connecticut River, Connecticut, opened March 13, 1889, by Col. D. C. Houston, Corps of Engineers.

No.	Names of bidders.	Rate per hour.	Guaranteed rate of excavation per hour.	Price per cubic yard.
			<i>Cubic yards.</i>	<i>Cmts.</i>
1	W. H. Beard, Brooklyn, N. Y.	\$12.00	60	20
2	Hartford Dredging Co., Hartford, Conn.	9.90	65	15½
3	Richard Parrott, Newburgh, N. Y.	9.50	50	19
4	J. H. Fenner, Jersey City, N. J.	9.45	60	14½

NOTE.—Amount available for contract, \$8,000.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1888.

Receipts and shipments by water.

	Tons.	Value.
Coal	300,000	\$1,500,000
Stone	400,000	2,500,000
Miscellaneous	350,000	55,000,000
Total	1,050,000	58,000,000

Vessels employed in above traffic.

[Draught, 7 to 12 feet.]

Description.	Number.	Tonnage.
Owued in district:		
Steamers	17	2,500
Sail vessels	50	5,000
Barges	23	4,000
Not owned in district:		
Vessels of all kinds	90	14,000
Total	180	27,500

D 4.

IMPROVEMENT OF CLINTON HARBOR, CONNECTICUT.

Clinton Harbor is on the north shore of Long Island Sound, about 10 miles west of the mouth of the Connecticut River. It consists of an open, shallow bay, and of the mouth of the Hammonasset River, a small stream which flows easterly in front of the town wharves and empties into the bay. For three-quarters of a mile above its mouth the river is separated from the bay by a narrow strip of sand and marsh. About 1840 a breach was made through this strip a half a mile above the mouth of the river, which diverted a considerable part of the tidal flow, and since then two shoals have formed, one just inside the river's mouth, with 4.5 feet of water, and one out in the bay shortly before reaching deep water in the sound, with a depth of 4 feet. It is said that formerly there were depths of from 8 to 12 feet on both these bars, and that shoaling occurred soon after the breach was made.

PROJECT FOR IMPROVEMENT.

By act approved March 3, 1881, Congress authorized a survey of the harbor, which was made the same year. In his report on the survey, dated January 17, 1882, and printed in the Annual Report of the Chief of Engineers for 1882, part 1, page 630, Colonel Barlow, Corps of Engineers, submitted a project for restoring the original condition of the channel by closing the breach and by subsequently, should the increased tidal current not produce the deepening desired, dredging through the shoals, making a channel 100 feet wide and 6 feet deep at mean low water.

The cost of a dike to close the breach was estimated at \$3,000, and the cost of the whole project, including the dredging, at \$10,000.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1888.

Nothing was done; the available funds were not sufficient for continuing the improvement.

PRESENT CONDITION OF IMPROVEMENT.

The dike was built in 1883, using 1,574 tons of riprap granite, and costing, exclusive of superintendence, \$2,219.34. An examination made in 1885 showed that it had settled about 2 feet and would require 500 tons of stone to build it up to full height; also that no material change in the channel had taken place since the dike was built. It seems established that the increase of tidal flow will not, of itself, deepen the channel as desired.

PROPOSED OPERATIONS.

It is proposed to complete the project by dredging channels 100 feet wide and 6 feet deep at mean low water through the two shoals in the harbor when the estimated funds, \$7,000, are appropriated.

The only appropriation made for improvement of this harbor is the one of \$3,000 in 1882, expended in construction of dike.

Clinton Harbor is in the collection district of Hartford. The nearest light-house is on Falkner's Island, 8 miles southwest. Fort Hale, New Haven Harbor, 23 miles west, is the nearest work of defense.

Money statement.

July 1, 1888, amount available	\$252. 73
July 1, 1889, balance available	252. 73
<hr/>	
{ Amount (estimated) required for completion of existing project.....	7, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	7, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1888.

Arrivals and departures of vessels	90 to 100
Shipments:	
Wood and lumber	tons .. 2, 000
Hay and straw	do .. 500
<hr/>	
Total	2, 500

Receipts:	
Coal	tons.. 1, 200
Lumber	M feet.. 108
Oysters	bushels .. 10, 000
Draught of vessels using the harbor	feet.. 4½ to 7½
Tonnage of vessels using the harbor	tons.. 30 to 150
No statistics for 1888 have been received. It is believed that the above fairly represents the present commerce of the harbor.	

D 5.

IMPROVEMENT OF NEW HAVEN HARBOR, CONNECTICUT.

New Haven Harbor is a bay on the north shore of Long Island Sound extending about 4 miles inland and from 1 to 2 miles wide. The Mill and Quinnipiac rivers empty into the head of the harbor; these rivers are of no commercial importance except for tidal navigation at and near their mouths.

The harbor channel is from 400 feet to a mile wide, with mud and sand flats on either side. When the Government began work in this harbor in 1867, the available low-water depth above Crane's Bar, about a third way down the harbor, was 9 feet; thence to Fort Hale, which is about half way down, it was 16 feet or over; a short distance below Fort Hale was a bar of very soft mud extending across the harbor, with 13 feet available depth at mean low water.

The entrance to the harbor was partly obstructed by several sunken rocks.

PROJECTS FOR IMPROVEMENT.

Several plans for removal of certain of the rocks at the harbor entrance have been proposed and undertaken, but not completed. The removal of the harbor light-house to Southwest Ledge and the completion of the present plan for breakwaters will obviate the necessity for further work upon the work.

The work of deepening the channel in this harbor has, for the most part, been done in accordance with plans presented in annual or special reports of the Chief of Engineers, the projects being adopted to com-

ply with subsequent appropriations, and not based upon examinations or surveys ordered by Congress.

In a letter dated January 20, 1871, printed as House Ex. Doc. No. 95, Forty-first Congress, third session, and also on page 771 of the Annual Report of the Chief of Engineers for 1871, General Warren says that "the business of New Haven requires that there should be a channel dredged 200 feet wide and to a depth of 14 feet at mean low water up to the wharves," and that this is "in many respects more important to New Haven than the removal of the rocks at the entrance to the harbor." It was estimated to cost \$64,815. March 3, 1871, \$40,000 was appropriated and expended in the same year in making a channel 13 feet deep, 200 feet wide up to Long Wharf, 350 feet wide at the bend at Long Wharf, and 100 feet wide from there to the steamboat wharf.

In a letter of December 23, 1871, printed in House Ex. Doc. No. 137, Forty-second Congress, first session, General Warren submitted an estimate of \$26,250 for dredging 16 feet deep and 200 feet wide, across Fort Hale Bar, adding that there was some doubt as to the permanence of such a channel. June 10, 1872, \$15,000 was appropriated for the removal of rocks and \$20,000 for harbor improvement. The former amount was expended upon Luddington Rock; the latter, with part of an appropriation of \$25,000 made March 3, 1873, was expended in dredging on the Fort Hale Bar, and at the close of the season of 1873 the channel had been made 15 feet deep and 200 feet wide, as proposed. It soon filled to nearly its former condition. The 13-foot channel above Long Wharf was also widened to 110 feet.

In the Annual Report for 1873 General Warren says :

It is thought that no improvement here, beyond what can be accomplished with the funds now available, is called for on the part of the United States, and no further appropriation is asked for.

No appropriation for this harbor was made in 1874, and none was recommended in the Annual Report for that year.

In a report dated January 27, 1875, in reply to the first part of a resolution of the House of Representatives, January 21, 1875, asking "for a report from surveys already made, in regard to the expediency of widening and deepening the main channel of New Haven Harbor, Connecticut, to a depth not exceeding 20 feet, and also the expediency and estimate of cost of a breakwater," Colonel Barlow, United States Engineers, then in charge, presented estimates. (See Annual Report for 1875, Part II, page 250.)

For channel 400 feet wide and 20 feet deep	\$416,490
For channel 400 feet wide and 18 feet deep	276,990
For channel 300 feet wide and 20 feet deep	329,925
For channel 300 feet wide and 18 feet deep	208,890

Also, February 8, 1875, in reply to request from the Chief of Engineers, he estimated \$10,000 as the cost of widening to 200 feet the 13 foot channel above Long Wharf, already 110 feet wide. In submitting these reports the Chief of Engineers recommended the latter work "as being of immediate importance, and whatever action may be taken upon the project of making a 20 foot channel, this at least should be done." In a subsequent report on the same matter, February 9, 1875, Colonel Barlow presents an estimate of \$35,000 for widening the channel above Long Wharf to 400 feet; this was transmitted to the House of Representatives by the Secretary of War, February 13, 1875, with favorable indorsement of the Chief of Engineers. This latter plan was carried out under the appropriation of \$10,000 made March 3, 1875, with a bal-

ance of about \$6,000 from previous appropriations, and the 13-foot channel was made 415 feet wide above Long Wharf, the price of work being much lower than had been estimated.

Nothing was appropriated for this harbor in 1876 or 1877.

In the Annual Report for 1877 Colonel Barlow refers to the estimates submitted in letter of January 25, 1875, and recommends that the channel below Long Wharf be made 400 feet wide and 16 feet deep, its then dimensions (200 feet wide and 13 feet deep) not affording "sufficient space for convenient navigation." The estimated cost was \$40,000.

In 1878, under an appropriation of \$25,000, made June 14, 1878, the channel was dredged to length and depth as proposed with width of 300 feet.

In a letter, February 4, 1879, transmitting map of harbor examination made in December, 1878 (letter printed in Annual Report of the Chief of Engineers for 1879, Part I, page 336), Colonel Barlow recommends deepening the channel above Long Wharf and widening that below to secure 400 feet width with 16 feet depth from the steam-boat wharf down to Fort Hale; also dredging a channel 500 feet wide and 16 feet deep through Fort Hale Bar; the work above Fort Hale was estimated to cost \$65,000, that below \$35,000. The proposed depth and slightly greater width above Fort Hale were obtained by October, 1881, under three successive appropriations of \$15,000 each in 1879, 1880, and 1881; nothing had been done on the Fort Hale Bar.

In the Annual Report for 1879 a dike at Sandy Point (opposite Fort Hale) was suggested as a means of increasing the depth on Fort Hale Bar, but on account of its expensiveness was not recommended to be undertaken until dredging had been tried again.

In the Annual Report for 1880 (Part I, page 445) Colonel Barlow renews his recommendation for dredging a channel through Fort Hale Bar 500 feet wide and 16 feet deep.

In the Annual Report for 1881 (Part I, page 592), after current observations and borings had been made, a dike from Sandy Point is recommended, the length to be determined experimentally as construction progresses, but to be at least 4,400 feet, which length was estimated to cost \$60,000.

Under appropriation of \$30,000 made August 2, 1882, a plan for this dike was submitted and referred to the Board of Engineers, by whom it was slightly modified and approved October 2, 1882. The project as approved consisted of a dike connected with Sandy Point by a shore-arm about 2,160 feet long, and extending southward as a channel-arm about 3,200 feet, the channel-arm and part of the shore-arm to be built of creosoted piling in double rows filled in with stone. In 1883 the location of the shore-arm was modified upon the request of oyster-growers in the vicinity, and in 1886 the method of construction was modified in order to use riprap instead of creosoted piling; the latter being found more expensive both to construct and to keep in repair.

The appropriations of 1882 and 1886 were expended upon the dike, building rather more than one-half of the work. The appropriation of 1884 was expended in dredging, under a special project for widening the channel above Long Wharf with depths of 8 and 12 feet, and for removing part of the piers and abutments of Tomlinson's Bridge, just above the steam-boat wharf, which bridge was at this time being rebuilt.

The present project for making a 16-foot channel across Fort Hale Bar includes the completion of the dike at an estimated cost of \$46,000, and dredging a channel 16 feet deep through the bar, which for 400 feet width is estimated to cost \$47,000; total \$93,000. (See revised esti-

mates, Annual Report of the Chief of Engineers for 1887, Part I, pages 599 and 600), to be reduced by \$15,000, appropriated August 11, 1888, making present estimate for completion \$78,000.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1889.

By act of Congress of August 11, 1888, \$15,000 were appropriated for this harbor. After due advertisement, proposals for furnishing riprap and extending the dike were received, and under date of January 19, 1889, a contract was entered into with John Beattie, of Leetes Island, Connecticut, to do the required work at the rate of \$1.16 per ton of riprap placed in the dike. Work was begun March 19, and up to the close of the fiscal year 5,081 tons of stone had been placed in the dike, extending it 410 feet. The contract is still in progress.

PRESENT CONDITION OF IMPROVEMENT.

The available depth over Fort Hale Bar is about 13 feet at mean low water. Above this bar there is a 16-foot channel up to Tomlinson's Bridge, at the head of the harbor, with from 400 to 600 feet width. Just below the sewer dock, on the west side of the channel, is an anchorage basin of about 2 acres area and 8 feet deep, and on the east side of the channel above Long Wharf an additional width of about 100 feet has been dredged 12 feet deep or over.

Of the Sandy Point Dike, the shore-arm, 2,140 feet long, and 1,769 feet of the channel-arm (including an ice-breaker 20 feet long) have been built; 1,294 feet of the inner end of the shore-arm are of riprap; the outer part of the shore-arm, 846 feet long, and 254 feet at the north end of the channel-arm are built of two rows of creosoted piling 8 feet apart from out to out, and filled in with stone; 1,495 feet of the channel-arm south of the pile work are built of riprap, of which the north 273 feet are on a log foundation; the ice-breaker at the north end of the channel-arm is also of heavy riprap on log foundations.

PROPOSED OPERATIONS.

With future appropriations the dike will be completed and the channel dredged through Fort Hale Bar. The estimated cost of this is \$78,000, to which should be added an estimate of \$5,000 annually required for maintenance of channels and for repair of dike.

Appropriations for the improvement of New Haven Harbor have been made as follows, viz:

Application.	Date.	Amount.
Removal of Middle Rock, not expended until 1867	Aug. 30, 1882	\$6, 000
Removal of rocks	July 11, 1870	15, 000
Dredging (13 feet) above Fort Hale	Mar. 3, 1871	40, 000
Dredging (16 feet) Fort Hale Bar and removal of rocks	June 10, 1872	35, 000
Dredging (16 feet) Fort Hale Bar	Mar. 3, 1873	25, 000
Dredging (13 feet) above Long Wharf	Mar. 3, 1875	10, 000
Dredging (16 feet) Long Wharf to Fort Hale	June 18, 1878	25, 000
Dredging (16 feet) above Long Wharf	Mar. 3, 1879	15, 000
Do	June 14, 1880	15, 000
Dredging (16 feet) Long Wharf to Fort Hale	Mar. 3, 1881	15, 000
Dandy Point Dike	Aug. 2, 1882	30, 000
Dredging (18, 12, and 8 feet) above Long Wharf	July 5, 1884	10, 000
Dandy Point Dike	Aug. 5, 1886	20, 000
Do	Aug. 11, 1888	15, 000
Total		278, 000

New Haven, the port of entry for the collection district of New Haven, is situated at the head of New Haven Harbor, about $3\frac{1}{4}$ miles from Long Island Sound. There is a light-house on Southwest Ledge, at the mouth of the harbor. Fort Hale, 2 miles below the city, commands the channel.

Money statement.

July 1, 1888, amount available	\$1,329.98
Amount appropriated by act of August 11, 1888.....	15,000.00
	<hr/> 16,329.98
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$3,650.21
July 1, 1889, outstanding liabilities	3,519.89
July 1, 1889, amount covered by existing contracts.....	8,000.00
	<hr/> 15,170.10
July 1, 1889, balance available.....	<hr/> 1,159.88
<hr/>	
{ Amount (estimated) required for completion of existing project	78,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	78,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for extending the dike in New Haven Harbor, Conn., opened December 13, 1888, by Col. D. C. Houston, Corps of Engineers.

No.	Name and address of bidder.	Rate per ton (10,000 tons).	Amount of bid.
1	James V. Luce, Niantic, Conn.....	\$1.52	\$15,200
2	Wm. H. Moltrop & Co., Gales Ferry, Conn.....	1.55	15,500
3	Charles H. Edwards, Boston, Mass.....	1.19	11,900
4	Fraucis H. Smith, New York City.....	1.43	14,300
5	John A. Bouker, New York City	1.35	13,500
*6	John Beattie, Leetes Island, Conn.....	1.16	11,600
7	S. & E. S. Belden, Rocky Hill, Conn.....	1.21	12,100

NOTE.—Amount available for contract work, \$13,000.

* Lowest bid; entered into contract January 7, 1889; in progress.

Commerce of New Haven Harbor for year ending December 31, 1889.

FOREIGN.

Value of imports.....	\$278,090.94
Value of exports.....	\$2,048,292.18
Revenue receipts	\$104,800.86
Foreign vessels entered from foreign ports.....	33
Foreign vessels cleared for foreign ports.....	17
Domestic vessels entered.....	840
Domestic vessels cleared.....	733

COASTWISE.

	Value.
Coal received (750,000 tons)	\$3,375,000
Iron received (98,000 tons).....	1,160,000
Lumber received (70,000,000 feet).....	3,800,000
Miscellaneous merchandise received.....	80,300,000
Miscellaneous merchandise shipped.....	70,600,000
Total.....	<hr/> 159,235,000

VESSELS ARRIVING AND DEPARTING.

Steamers	8,250
Sail-vessels	10,950
Barges in tow	7,760
Total.....	<hr/> 26,960

D 6.

CONSTRUCTION OF BREAKWATER AT NEW HAVEN, CONNECTICUT.

New Haven Harbor is the only accessible natural harbor of any considerable area and depth in Long Island Sound, between New London Harbor, 45 miles east, and Huntington Bay, 32 miles southwest. At this point Long Island Sound is at its widest, and the broad, open mouth of the harbor left the anchorage ground exposed to storms from a southerly quarter, so that vessels driven in by stress of weather were frequently obliged to cross Fort Hale Bar, going from 2 to 4 miles up the harbor, and to anchor in the dredged channel in order to reach secure shelter.

PROJECT.

December 15, 1874, the Harbor Commissioners of New Haven addressed a memorial to the members of Congress from Connecticut asking that measures be taken "to procure appropriations by Congress for deepening the main ship-channel of the harbor to 20 feet, and for constructing a breakwater from the light-house [then on Five-Mile Point] to Southwest Ledge." The memorial, printed in House Ex. Doc. No. 162, Forty-third Congress, second session, stated that the breakwater contemplated would add greatly to the value of the harbor as a harbor of refuge.

January 21, 1875, a resolution was passed by the House of Representatives asking "for a report, from surveys already made, in regard to the expediency of widening and deepening the main channel of New Haven Harbor, Connecticut, to a depth not exceeding 20 feet, and also the expediency and estimate of expense of a breakwater between the eastern shore of the entrance of said harbor and Southwest Ledge, so called, or such part of said distance as may be found most expedient or necessary for the protection of said harbor." In reply to this resolution a report was made by Col. J. W. Barlow, Corps of Engineers, dated January 27, 1875, printed in House Ex. Doc. above mentioned, and also in the Annual Report of the Chief of Engineers for 1875, Part II, page 251, suggesting three locations for a breakwater, viz :

1. That indicated in the resolution and terminating at Southwest Ledge.

2. A line running nearly east and west, its middle point resting upon Adam's Fall Rock, about one-half a mile north of Southwest Ledge.

3. A line 400 yards further north running nearly west from Five-Mile Point.

Estimates of cost ranging from \$248,000 to \$465,330 were submitted, and with the report were also presented letters and commercial statistics bearing upon the subject.

The question of a westerly breakwater does not appear to have been considered at that time.

This report is referred to by Colonel Barlow in the succeeding annual reports for 1876, 1877, and 1878, and in the latter year additional statistics were submitted, but no action was taken until 1879, when an appropriation of \$30,000 was made "for the construction of a breakwater at New Haven, Conn."

In August of the same year an examination of part of the mouth of the harbor was made, and a map transmitted to the Chief of Engineers with several projects for breakwaters, which were referred to the Board

of Engineers for report. The report of the Board, dated November 24, 1879, and printed in the Annual Report of the Chief of Engineers for 1880 (Part I, pages 449 to 452), recommended a breakwater from Southwest Ledge to Quixes Ledge, as contemplated in the resolution of the House of Representatives of January 21, 1875; but, as the anchorage ground would still be exposed to southwesterly gales, the Board stated as its opinion that a breakwater extending northwest from Luddington Rock would be necessary. Their plan provided for two riprap breakwaters, 12 feet wide on top, rising 6 feet above high water, with exterior slopes of one on three and interior slopes of two on three, with estimates as follows:

ESTIMATES FOR BREAKWATER FROM LIGHT-HOUSE LEDGE TO QUIXES LEDGE.

Length of construction, yards.....	1,100
Average height of work, feet.....	32
Average cross-section, yards.....	299
Cost per cubic yard.....	\$2
328,900 cubic yards, at \$2.....	\$657,805

ESTIMATES FOR BREAKWATER IN THE VICINITY OF LUDDINGTON ROCK.

Length, yards.....	1,400
Average height, feet.....	28
Cross section, square yards.....	2334
326,667 cubic yards, at \$2.....	\$653,334

This plan locates the easterly breakwater so as to lie between Light-house Ledge (or Southwest Ledge), and Quixes Ledge, and the westerly one to extend in a northwest and southeast direction, overlying Luddington Rock. This report was transmitted to the Secretary of War by the Chief of Engineers, with the suggestion that the appropriation (\$30,000) be applied toward the construction of the easterly breakwater, and was approved by him January 31, 1880. Before work had been begun the details of cross-section were modified with the approval of the Chief of Engineers, so that the exterior slope should be one on two, and the interior one on one.

The first load of stone was delivered April 22, 1880, beginning the east breakwater at the end resting upon Southwest Ledge; under subsequent appropriations it has been extended northeasterly, and up to July 1, 1888, 2,818 linear feet of this breakwater has been built, using 246,971 tons of granite.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1889.

The contract with John Beattie, dated May 11, 1888, which was in progress at the close of the last fiscal year, was completed August 31, 1888; 5,478 tons of granite having been placed in the breakwater, increasing its length by 67 feet and making its total length 2,870 feet. Of these amounts 4,227 tons of stone were delivered and 52 linear feet of breakwater were built since July 1, 1888.

The act of Congress of August 11, 1888, appropriated \$75,000 for construction of breakwater, and provided that—

The Chief of Engineers may, if deemed necessary, relocate the western breakwater; and the Secretary of War is authorized, in his discretion, to expend any portion of said sum in commencing its construction.

Proposals for delivery of riprap and enlarging and extending the east breakwater were opened December 13, 1888, and January 7, 1889, a contract was entered into with John Beattie, of Leete's Island, Conn.,

for delivery of about 30,000 tons of riprap granite, at the rate of \$1.22 per ton.

Work under this contract was begun January 14, and up to June 30, 16,067 tons of granite had been delivered, extending the breakwater 300 linear feet.

The contract is still in progress.

The total amount of stone delivered in the breakwater during the fiscal year was 20,294 tons, and the length of work built was 352 feet.

With approval of the Chief of Engineers an arrangement has been entered into with John Beattie for purchase and delivery, as an open-market transaction, of about 12,000 tons of riprap, which it is estimated will be sufficient to wholly complete the east breakwater. The rate is \$1.22 per ton, the same as the present contract prices.

In September and December, 1888, an examination was made, and a series of borings was taken, in order to present estimates of cost of relocation of the westerly breakwater, as authorized by the act of Congress. A report upon this, dated January 26, 1889, was submitted to the Chief of Engineers, and, with accompanying papers, is attached to this report.

PRESENT CONDITION OF WORK.

The east breakwater is now 3,170 feet long; it contains 267,265 tons of stone, and has cost (supervision, etc., included) about \$100 per linear foot. The part first built has settled slightly and needs repairing, and the outer or seaward slope is not built out quite to the required slope of one-half.

PROPOSED OPERATIONS.

Under the contract now in force, and under the open market purchase of about 12,000 tons of stone, at rates not exceeding the contract price, it is proposed to extend the east breakwater to and across Quixes Ledge, to the edge of the channel on the east side of the rock, a total length for the breakwater of about 3,450 feet; to repair the part which has settled, and to strengthen the seaward slope. This will complete the easterly breakwater to its full dimensions.

The river and harbor act of August 11, 1888, provided—

And the Chief of Engineers may, if deemed necessary, relocate the western breakwater; and the Secretary of War is authorized, in his discretion, to expend any portion of said sum in commencing its construction.

An examination in reference to this matter was made in the fall of 1888, and the results reported in my letter to the Chief of Engineers, dated January 26, 1889 (copy attached). The estimated cost of a harbor such as would meet the wishes of the harbor commissioners is \$5,000,000. So large an expenditure does not seem to be warranted by the present demands of commerce. At the same time the harbor as designed is not of sufficient capacity, and is now exposed to southerly and southwesterly storms. Vessels will not lie at anchor immediately behind the easterly breakwater, owing to the existence of submerged rocks having over them a minimum depth of 5 feet, so that the anchorage ground which it really protects is that above Five-Mile Point, which is limited in area, and its use by vessels seeking refuge interferes with the channel to the wharves at New Haven. What is needed is a harbor easily accessible and the occupation of which will not interfere with the local harbor. They should be two distinct harbors.

The entrance to the harbor, according to the present plan, between Luddington Rock and Southwest Ledge is 3,500 feet wide. This width is unnecessarily great and might be reduced without interfering with the free passage of vessels and better protection be afforded the harbor.

From a personal examination, I am of the opinion that the present and prospective demands of commerce for a long time to come would be met by changing the location of the western breakwater to the south-westward about 6,000 feet, and constructing a breakwater crossing Luddington Rock on a course S. 54° W., commencing at a point on this line 1,000 feet N. 54° E. from Luddington Rock and extending S. 54° W. 5,000 feet, leaving an opening of 2,000 feet or less between its western end and the southern end of the westerly breakwater in its proposed change of location. The location of these works is shown on the accompanying sketch. The cost, in addition to the present estimates (viz, \$1,311,134) will be about \$750,000. The space behind the breakwater proposed through Luddington Rock is free from obstructions and has a depth of from 15 to 20 feet, with good holding ground; it can be reached at the eastern end with a depth of 17 feet, and at the western end with a depth of 28 feet. This plan will not interfere with its extension farther to the westward should the necessities of commerce demand it in the future.

This work should commence at Luddington Rock and extend in both directions as funds are provided. This rock, which now forms an obstruction, will be covered by the breakwater, and a permanent beacon at the eastern end will, with the light-house on Southwest Ledge, clearly mark the entrance. The entrance between them will be 2,500 feet wide, with a minimum depth of 17 feet and a maximum of 25 feet.

For the better protection of the harbor, the space between the eastern breakwater and the shore, a distance of 2,000 feet, should be partially closed by a breakwater, extending from the shore towards the eastern end of the easterly breakwater, leaving an opening in the present eastern channel, 13 feet deep, of 800 feet. The cost of this is estimated at \$90,000. This is not so important as the works proposed on the western side of the harbor, and may be deferred until they are completed.

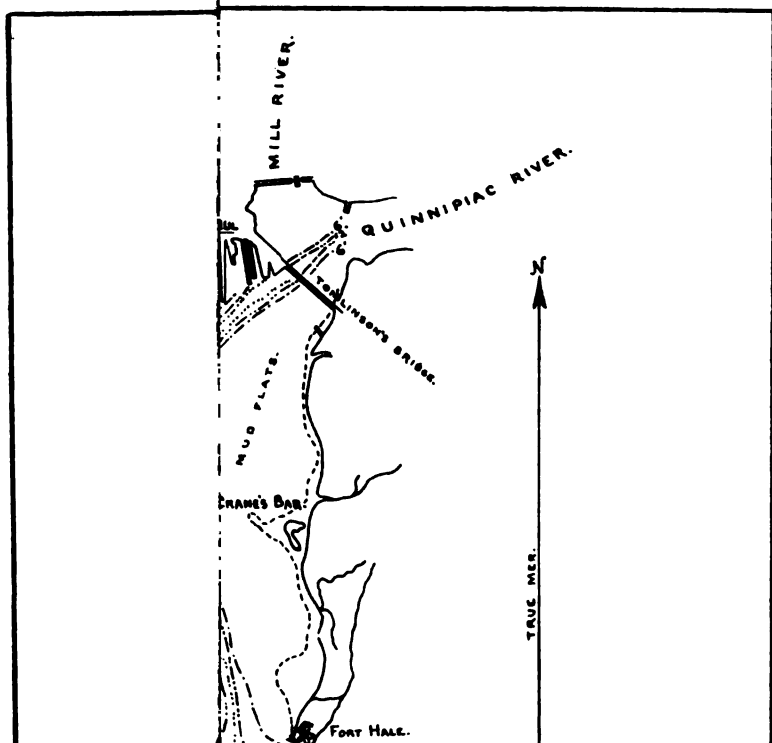
With future appropriation it is proposed to construct the westerly breakwater in accordance with either the original plan or with such relocation as may be made by the Chief of Engineers under the special authority conveyed by Congress.

In either case, during the ensuing year \$500,000 could be profitably applied to construction of the westerly breakwater.

Appropriations for the New Haven Breakwater have been made as follows:

Date.	Application.	Amount.
Mar. 3, 1879	East breakwater.....	\$30,000
June 14, 1880	do.....	20,000
Mar. 3, 1881	do.....	60,000
Aug. 2, 1882	do.....	60,000
July 5, 1884	do.....	40,000
Aug. 5, 1886	do.....	75,000
Aug. 11, 1888	Completing breakwater.....	75,000
	Total	\$70,000

New Haven, the port of entry for the collection district of New Haven, is situated at the head of New Haven Harbor, about 4 miles north of the breakwater. There is a light-house on Southwest Ledge, at the west terminus of the east breakwater. Fort Hale, 2 miles north of the breakwater, commands the channel.





Money statement.

July 1, 1888, amount available.....	\$91.21
Amount appropriated by act of August 11, 1888.....	75,000.00
	75,091.21
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$17,845.66
July 1, 1889, outstanding liabilities.....	4,530.24
July 1, 1889, amount covered by existing contracts.....	29,280.00
	51,655.90
July 1, 1889, balance available	23,435.31
{ Amount (estimated) required for completion of existing project..... 941,134.00 Amount that can be profitably expended in fiscal year ending June 30, 1891 500,000.00 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for breakwater at New Haven, Conn., opened December 13, 1888, by Col. D. C. Houston, Corps of Engineers.

No.	Name and address of bidder.	Rate per ton (30,000 tons.)	Amount of bid.
1	Francis H. Smith, New York City.....	\$1.45	\$43,500
*2	John Beattie, Leetes Island, Conn.....	1.22	36,600

* Lowest bid; entered into contract January 7, 1889; contract in progress.

NOTE.—Amount available for contract work \$67,500.

COMMERCIAL STATISTICS FOR YEAR ENDING DECEMBER 31, 1888.

Vessels passing New Haven Breakwater.

Vessels.	Number.	Vessels.	Number.
Men of war.....	35	Schooners and sloops.....	16,190
Steam-ships.....	2,450	Barges in tow.....	24,300
Ships, barks, and brigs.....	875		
Steamers of all kinds.....	23,400	Total.....	66,250

These figures are not complete, as many vessels would pass unobserved in night or in thick weather.

REPORT ON EXAMINATION WITH REFERENCE TO RELOCATION OF WESTERN BREAKWATER.

ENGINEER OFFICE, U. S. ARMY,
New York, January 26, 1889.

GENERAL: I have the honor to submit the following report on an examination made with reference to relocating the western breakwater at New Haven, Conn., as provided for in the river and harbor act of August 11, 1888, viz:

Improving breakwater at New Haven, Conn., continuing improvement, \$75,000; and the Chief of Engineers may, if deemed necessary, relocate the western breakwater; and the Secretary of War is authorized, in his discretion, to expend any portion of said sum in commencing its construction.

I inclose a tracing* showing the results of this examination, character of bottom, etc.

Under the present project the western breakwater is to extend in a northwesterly direction from Luddington Rock so as to protect the anchorage under the easterly breakwater (now nearly completed) from southwesterly storms, and thus form a harbor of refuge, protected from storms in all directions. It is represented by the Harbor Commissioners of New Haven that such a harbor would not have sufficient capacity for the present and future demands of commerce, and they have proposed a large harbor to the westward, as explained in their letter of October 13, 1887, with accompanying sketches (returned herewith).

The present examination has been made with a view to making estimates for works necessary to provide a large harbor of refuge southwesterly of Luddington Rock, and has consisted principally in borings to determine the character of the bottom. These borings were at first made on a line running S. 54° W. from Luddington Rock for a distance of about 2½ miles, and thence in a direction N. 65° W. for a distance of about 1 mile, it being assumed that these lines would afford the most desirable locations for breakwaters to protect a large harbor. The result of the borings was to develop a deposit of soft mud from 2 to 3 miles west of Luddington Rock as great, in places, as 28 feet deep in a depth of 33 feet of water. I therefore directed borings to be made so as to cover the entire area where works would probably be located. I have indicated on the tracing a plan for a large harbor, as follows: First, a breakwater to commence at Luddington Rock and extend in a southwesterly direction about 2 miles; second, a breakwater to commence at a point in the prolongation of the first and about one-half mile from its western extremity and extending in a northwesterly direction about 1 mile. The cost of these works is estimated at about \$5,000,000. A large portion of this cost is due to the deposit of mud above referred to. As this deposit diminishes to the eastward, as shown on the tracing, as well as the depth of water, a harbor could be constructed at less cost, but at a sacrifice of area and depth of water. No adequate harbor can be made here except at great cost. The estimated cost of the western breakwater under the present project is \$653,334. To relocate it as desired, in a southwesterly direction from Luddington Rock, involves not simply a change of place, but a large additional expenditure, for which no estimates have been submitted to Congress. The question of a large harbor here should be considered in connection with the general subject of harbors of refuge on Long Island Sound.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

LETTER FROM CAPT. CHARLES HARVEY TOWNSEND, TRANSMITTING COMMUNICATIONS REFERRING TO PROPOSED RELOCATION OF WESTERLY BREAKWATER.

OFFICE BOARD OF HARBOR COMMISSIONERS,
New Haven, Conn., January 10, 1889.

SIR: In compliance with your request to the Harbor Commissioners "for New Haven Harbor," dated New York, May 24, 1888, I have after much delay been able to collect the inclosed statistics of values transported through Long Island Sound to and from foreign and domestic ports; also an estimate from numerous sources; also with com-

* Omitted.

mercial statistics from the collector of customs of the port of New Haven, Conn., for the fiscal year ending June 30, 1888, and the customs collections during the past thirty years from June 30, 1855, to June 30, 1887, inclusive. Total, \$9,072,080.

The exact amount of value transported can not, as you are aware, be perfectly obtained, but enough has been collected from official sources to base this estimate, reaching approximately the sum total of upwards of \$1,000,000,000, or in exact figures \$1,029,064,990.

This amount may seem very large, but when I estimate the value of vessels used in this transportation I feel warranted in doubling the estimate (say, \$2,000,000,000).

I also inclose copies of letters from distinguished officers of our navy and merchant marine, together with petitions and other papers bearing the indorsement of the proposed plans by the president of the New Haven chamber of commerce, the president of the New York chamber of commerce, the president of the vessel-owners and captains' society, the president of the marine society, and also the president of the maritime association of the port of New York.

Hoping this collection of material will be useful, the whole showing the importance of the Government granting immediate and liberal amounts to complete this most necessary and long-needed want,

I am, very respectfully, your obedient servant,

CHAS. HARVEY TOWNSEND.

Col. D. C. HOUSTON,
Corps of Engineers, U. S. A.

Estimate of value of merchandise annually transported through Long Island Sound to and from the city of New York, from New Haven, Conn., and other eastern ports, fiscal year ending June 30, 1888.

New York and New Haven, per steamer	\$360,000,000	
coal	3,128,400	
iron	1,674,000	
lumber	2,862,000	
oysters	3,000,000	
Miscellaneous merchandise received	72,160,230	
shipped	59,320,840	
		403,145,470
Hartford and Connecticut River, per steamer	\$720,000	
coal	880,000	
iron	500,000	
stone	150,000	
lumber	1,000,000	
Miscellaneous merchandise received	23,260,000	
shipped	11,234,520	
		37,744,520
Norwich and New London steamer	200,000,000	
Providence and Stonington steamer	104,000,000	
Old Colony and Newport steamer	200,000,000	
New Bedford steamer	50,000,000	
New York and Boston steamer	20,000,000	
Portland, Me., steamer	10,400,000	
Lumber, Maine steamer	3,475,000	
Spruce piling, Maine (about)	300,000	
Total		1,029,064,990

The above estimate has been compiled from original documents in my possession.

CHAS. HARVEY TOWNSEND,
Harbor Commissioner of New Haven Harbor.

NEW HAVEN, CONN., January 10, 1889.

LETTER OF THE PRESIDENT AND CORRESPONDING SECRETARY OF THE NEW HAVEN CHAMBER OF COMMERCE.

CHAMBER OF COMMERCE (ORGANIZED 1794),
New Haven, Conn., October 31, 1888.

SIR: The New Haven Chamber of Commerce respectfully ask your indorsement to their memorial to Congress for advancing the construction of the breakwaters and other improvements off the port of New Haven, Conn., for the general benefit of for-

eign and domestic commerce, believing that whatever tends to benefit the commerce of Long Island Sound is a direct benefit to New York through the interstate commerce centering at your port.

The measure has received the approval of commercial men from Maine to Georgia, and we respectfully ask the added weight of your indorsement.

[Seal of Chamber of Commerce of New Haven.]

JAMES D. DEWELL,
President.

T. ATTWATER BARNES,
Corresponding Secretary.

To the President of Vessel Owners' and Captains' Co-operative Association.

Approved.

JAMES A. VAN BRUNT,
President Vessel Owners' and Captains' Co-operative Association.

A copy of this letter addressed to "The President of the Marine Society" received the signature of Ambrose Snow, president of that society.

LETTER OF RADCLIFFE BALDWIN, PRESIDENT OF THE NEW YORK MARITIME ASSOCIATION.

THE MARITIME ASSOCIATION OF THE PORT OF NEW YORK,
PRODUCE EXCHANGE BUILDING, BRAVER STREET,
New York, December 12, 1888.

DEAR SIR: At a meeting of the board of directors held this day a communication from your chamber, addressed to the president of this association, was received, and the following resolution unanimously adopted:

Resolved, That this association indorse the memorial to Congress of the Chamber of Commerce of New Haven for advancing the construction of breakwaters and other improvements off the port of New Haven, Conn.

Very respectfully, yours, etc.,

RADCLIFFE BALDWIN,
President.

Attest.

WM. H. VAN BRUNT,
Secretary.

Mr. T. ATTWATER BARNES,
Sec'y Chamber of Commerce, New Haven, Conn.

LETTER OF COMMANDER F. M. GREEN, U. S. N.

NAVIGATION OFFICE,
Navy-Yard, New York, December 17, 1888.

MY DEAR SIR: In answer to your inquiries I beg to say that having commanded a ship of the North Atlantic squadron during the years 1886 and 1887, I have had frequent opportunities of noticing the enormous traffic passing through Long Island Sound, both by sail and steam, and have been particularly interested in it from the fact that before entering the U. S. Naval service I was for many years engaged in the merchant marine. Among the many striking features of the traffic along the coast, I have been much impressed with the very great and growing value of the harbor of New Haven as a port of refuge. A visit to that place with the North Atlantic squadron in the summer of 1886 made me better acquainted with the great advantages, both present and prospective. During my visit the ships lay just inside the breakwater in about 4 fathoms, an excellent summer anchorage and well protected from southeast gales at all seasons. When, however, the new breakwater, stretching south-eastwardly from the west shore shall have been completed, the benefit to the coasting trade will be great indeed. Situated at the widest part of the sound, the sea caused by a wind from any point between southwest and southeast is very heavy, and the nearest shelter is New London nearly 40 miles away. The clearing away of the obstructions in Hell Gate and the increasing commerce of the East River, as well as the improvements now making in Harlem River, have wonderfully increased the number of vessels passing through Long Island Sound and will do so still more, and every navigator on board of them will be thankful to have such a harbor of refuge so accessible and so safe to avail themselves of. Few people realize, until they have navigated this coast constantly in bitter winter weather and in the numerous fogs which beset our shores, the enormous value, both in money and comfort, of securing harbors

of refuge. I have designedly omitted speaking of the military advantages of such a harbor, which are very great, but the benefits to be derived by the thousands of schooners and steamers passing through the Sound is ample to more than justify the building of the proposed breakwater.

Very truly yours,

F. M. GREEN.

Commander U. S. N., Navigation Officer.

CHARLES H. TOWNSEND, Esq.,
New Haven, Conn.

LETTER OF COMMANDER C. M. CHESTER, U. S. N.

UNITED STATES STEAMER GALENA,
Navy-Yard, New York, November 30, 1888.

MY DEAR SIR: During the past three years as commander of this vessel it has been my pleasure to visit New Haven several times.

I have, while deprecating the distance at which a ship of the size of the *Galena* had to anchor from the city, been struck by the excellent possibilities of the harbor. These impressions have only confirmed me in the views formed from a careful study of the great water sheet extending from Block Island, between Long Island and Connecticut, when, while in charge of the hydrographic branch of the United States Coast Survey, I had a plan for the resurvey of the Sound.

It is indispensable that in the near future Long Island Sound will become a most important entrance for the commerce to the great port of New York. Even at this date the traffic through Hell Gate is immense. New Haven occupies a central position between New York City and the "Race," with no harbor for 50 or 60 miles on either side of it. That a safe harbor at this point is a necessity is apparent to all seafaring men.

The breakwater already built has fortunately provided a refuge for vessels during a southeasterly gale; but for those, stronger as a rule, from the southwest no provision has been made. A short time ago the press was filled with an account of a terrible catastrophe which had happened to a United States revenue vessel just outside of the breakwater; it was reported she had been overwhelmed by the sea and all hands lost, but happily the rumor was ill founded, and she escaped after a fearful wrestling with the waves, being much damaged in the encounter.

Last summer I experienced one of those southwest gales, and, although provided with a steam-launch, was compelled to give up an attempt to reach the ship at anchor in the outer harbor and remain on shore, anxious lest she should follow most of the other vessels present and drift ashore. The breakwater, in the construction of which many of your citizens are interested, would not only prevent such accidents, but would make this one of the finest harbors on the coast.

As a naval officer, I would like to add that when the subject of our coast defenses, now fast growing in importance, shall be properly considered, New Haven, with a harbor such as the breakwater would make it, with accommodations for our largest iron-clads, will become of vast strategic value to the country; for where, may I ask, have we another single port in the vicinity of the metropolis which will allow the entrance of a vessel drawing 30 feet of water at all stages of the tide, save, perhaps, the exposed one of Gardiner's Bay? One can imagine what England would give for a place of like natural advantages. How long would she be in building up a grand harbor; and wonder why the money from our own great resources is not immediately forthcoming to carry out the suggestions of the harbor commissioners of New Haven, supported by petitions to Congress from important citizens, representing the whole Atlantic seaboard?

Very respectfully, yours,

C. M. CHESTER,

Commander U. S. Navy, Commanding Galena.

Capt. CHAS. H. TOWNSEND.

LETTER OF MR. JAS. M. TOWNSEND.

"RAYNHAM," TOWNSEND AVENUE,
New Haven, Conn., January 10, 1887.

DEAR BROTHER: I must call your attention to the large fleet of vessels that sought refuge in New Haven Harbor during one of the very heavy gales last autumn. One afternoon, before the "gale broke," I counted one hundred and seventeen (117) sail

of vessels of all classes at anchor from Long Wharf, in the channel, to the breakwater. The vessels under the lee of the breakwater seemed to have little protection when the wind shifted to the southwest, and when it veered more westerly, and at low tide, they lay across the channel, blockading the whole approach to the wharf.

Upon inquiry, I find it is the opinion of vesselmen, owners of vessels, as well as those who sail them, that the same protection, or ample protection, should be made for vessels exposed to the southwest gale as is now being furnished against southeast gales on the east side of the harbor, and that the Government should at once appropriate liberal and sufficient sums for the west breakwater, which, in the opinion of all who know the necessity of it, should be hurried to completion.

Sincerely, yours,

JAS. M. TOWNSEND.

Capt. CHAS. HARVEY TOWNSEND,
New Haven, Conn.

LETTER OF MR. JOHN C. BYXBEE, COLLECTOR OF CUSTOMS AT NEW HAVEN.

CUSTOM-HOUSE, COLLECTOR'S OFFICE,
New Haven, Conn., January 7, 1889.

DEAR SIR: Inclosed please find commercial statistics for the fiscal year ending June 30, 1888; also custom receipts at this port for the past thirty-three years, from June 30, 1855, to June 30, 1888, inclusive.

The last showing that upwards of \$9,000,000 have been paid into the Treasury of the United States during this brief period would seem to warrant the Government in granting *liberal appropriations* for the general benefit of foreign and domestic commerce, by indorsing the plans of the U. S. Engineers in the scheme for locating a place of refuge off the entrance of this port.

This measure has received the approval of commercial men from Maine to Georgia who are interested in establishing these important works on the east approach to the port of New York, and securing such an important position for a spacious harbor of refuge for vessels of the larger class, making a rendezvous and base of operations for our naval vessels in time of war engaged in defending the coasts of Long Island Sound from the approach of hostile fleets.

Yours, truly,

JOHN C. BYXBEE,
Collector of Customs.

Capt. C. H. TOWNSEND,
New Haven.

COMMERCIAL STATISTICS FOR THE FISCAL YEAR ENDING JUNE 30, 1888.

Foreign.

Receipts of duties on imports.....	\$243, 722. 73
Miscellaneous receipts.....	\$1, 593. 50
Value of merchandise imported.....	\$558, 967. 92
Value of merchandise exported.....	\$2, 566, 233. 00
Number of vessels entered from foreign ports.....	41
Number of vessels cleared for foreign ports.....	23
Total foreign tonnage.....	9, 812

Coastwise.

Sailing vessels entered.....	18, 230
Sailing vessels cleared.....	18, 230
Steam-vessels entered.....	9, 300
Steam-vessels cleared.....	9, 300
Value of coal received (695,200 tons).....	\$3, 128, 400. 00
Value of iron received (93,000 tons).....	\$1, 674, 000. 00
Value of lumber received.....	\$2, 862, 000. 00
Value of oyster business.....	\$2, 600, 000. 00
Value of miscellaneous merchandise received.....	\$73, 160, 230. 00
Value of miscellaneous merchandise shipped.....	\$59, 320, 840. 00

Recapitulation.

Total receipts.....	\$245,316.23
Value of merchandise imported.....	558,967.92
Value of merchandise exported.....	2,566,233.00
Value of merchandise coastwise.....	82,424,630.00
Value of merchandise shipped.....	59,645,840.00

Total..... 145,441,987.15

Total tonnage of vessels tons.. 550,600

STATISTICS OF CUSTOM-HOUSE AT NEW HAVEN, CONNECTICUT, THE LAST THIRTY-THREE YEARS, FROM JUNE 30, 1855, TO JUNE 30, 1887, INCLUSIVE.

The following table will show the collections as follows:

1855.....	\$230,325	1873.....	344,069
1856.....	286,875	1874.....	378,128
1857.....	280,510	1875.....	350,339
1858.....	198,445	1876.....	409,048
1859.....	163,363	1877.....	298,028
1860.....	144,721	1878.....	312,805
1861.....	66,687	1879.....	299,028
1862.....	220,362	1880.....	344,998
1863.....	245,423	1881.....	257,556
1864.....	184,884	1882.....	482,872
1865.....	284,391	1883.....	245,272
1866.....	286,804	1884.....	288,628
1867.....	288,055	1885.....	302,228
1868.....	267,467	1886.....	161,974
1869.....	261,411	1887.....	245,316
1870.....	325,303		
1871.....	300,644		
1872.....	222,236		
		Total	9,072,080

D 7.

IMPROVEMENT OF MILFORD HARBOR, CONNECTICUT.

This harbor is on the north shore of Long Island Sound, about 9 miles southwest of New Haven, Conn. It consists of a broad, open bay, from the head of which the Wepawog River, a small tidal stream, extends three quarters of a mile north to the Milford Wharves, and the Indian River, another small inlet, extends northeasterly. The mouth of the latter stream is partly closed by a dam formerly used to create power for a tide-mill.

The original depth on the bar just outside the mouth of the rivers was less than 2 feet at mean low water, and in some places between there and the upper wharves low tide left the channel nearly bare.

The mean rise of the tide is 6.2 feet.

PROJECTS FOR IMPROVEMENT.

A survey of breakwater at Milford, Conn., was ordered by Congress in the river and harbor act of 1872. There being no breakwater, a survey of the harbor was made for a breakwater, and in his report, dated December 21, 1874, (printed as part of Ex. Doc. No. 107, Forty-second Congress, third session, and also on page 1041 of the Annual Report of

the Chief of Engineers for 1873), General Warren, U. S. Engineers, submitted the following plan of improvement:

1. A riprap breakwater from Welch's Point, on the east side of the mouth of the harbor	\$67,000
2. Protecting the bluffs on the east shore from erosion by means of small stone jetties	5,500
3. Dredging 4 feet deep and 100 feet wide across the bar at the mouth of the river	6,250
4. A jetty on the east side of the channel, to prevent the dredged area from filling and to confine the action of the tide	5,000
Superintendence	1,250
Total	85,000

In 1874 \$5,000 was appropriated for this harbor, and work under the above project was begun, building the small jetties, to protect the east shore. Twelve such jetties were built 100 to 130 feet long, and rising to 9 feet above mean low water line. The appropriation of 1875 (\$13,000) was applied to the repair of these jetties, to construction of a jetty from the east shore, at the mouth of Indian River (Long Jetty), and to dredging across the bar.

In the Annual Report for 1876 (see Annual Report of the Chief of Engineers for 1876, Part I, page 225) Colonel Barlow, U. S. Engineers, recommended that the dredged channel be carried up to the Town Wharf, about a half mile further, at an additional estimated cost of \$9,000.

This recommendation was renewed in 1877, and was included in the project for expenditure of the appropriation of \$10,000 made in 1878. In that and the following year the 4-foot channel across the bar was completed to 180 feet width as originally projected, and was extended to Town Wharf with width from 60 to 75 feet, and Long Jetty was repaired; also under the same appropriation, in 1879 and 1880, an additional jetty, authorized by Department letter of October 16, 1889, was built on the west side of the channel extending southward from Burns's Point. This appropriation completed the original project except the breakwater; sufficient money for beginning that had not been appropriated.

June 14, 1880, \$5,000 was appropriated, and in accordance with a project for its expenditure submitted and approved, the 4-foot harbor channel was extended from Town Wharf to the Straw Works Wharf, at the upper end of the harbor, with a width of 40 feet. This was completed before the appropriation was exhausted, and "at the earnest solicitation of those most interested in the works of improvement there, an experimental channel 25 feet wide and 8 feet deep was cut through the bar at the entrance lying within and on the west side of the 4-foot channel already made. This is now of great use to the steam-vessels employed in the fish-oil works at that place, and it is claimed that the increase of shipping in the harbor, particularly in the oyster business, for which those waters seem very well adapted, will soon require an 8-foot channel of fully 100 feet width. Such a channel would involve the removal of about 45,000 cubic yards more of material, principally sand and gravel, which, at ruling prices, would cost, including superintendence and incidental expenses, about \$11,000. (Extract from Colonel Barlow's Annual Report of 1881. See Annual Report of the Chief of Engineers for 1881, Part I, page 598 and 599.)

Under the appropriation of \$5,000 made August 2, 1882, the project above suggested was adopted and the 8-foot channel was widened to 65 feet from the bay up to Merwin's Wharf, with 100 feet width around the bend at Burn's Point.

By act of Congress approved March 3, 1871, a survey for a break-

water and harbor of refuge at Milford Harbor was authorized. The survey was made, and a report, with estimates, was submitted January 20, 1882. This report is printed in the Annual Report of the Chief of Engineers for 1882, Part I, page 632.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1889.

By act of Congress of August 11, 1888, \$5,000 were appropriated "to complete improvement." The project for expenditure of this appropriation, as approved, contemplated dredging to make the 8-foot channel 100 feet wide, and, if practicable, making some repairs to Long Jetty.

Proposals for dredging were received under date of February 4, 1889, and a contract was entered into with the Hartford Dredging Company, of Hartford, Conn., to do the required work at the rate of 18 cents per cubic yard. Work under this contract was begun May 2, and completed June 21; 18,000 cubic yards being removed and the 8-foot channel being made 100 feet wide or over across the bar at the mouth of the river.

After the contract for dredging was awarded, it appeared that a part of the appropriation could be applied to repair of Long Jetty; authority was granted for doing this by purchase in open market, and 265 tons of new stone were purchased and delivered at cost of \$2.50 per ton, and 395 tons of stone were removed from the outer end of the jetty and placed to reinforce the side slopes at cost, for labor of removal and replacing, of \$1.25 per ton.

The jetty was shortened by about 60 feet; this was rendered necessary by the widening of the 8-foot channel.

PRESENT CONDITION OF IMPROVEMENT.

The channel, dredged 4 feet deep, with width of 60 feet for about two-thirds distance from the mouth of the river to the straw-works wharf, and width of 40 feet the rest of the distance, is understood to be in good condition, having filled but little.

The channel across the bar is now 8 feet deep and over 100 feet wide.

Long Jetty, on the east bank at the mouth of Indian River, needs further repairs; the other jetties need slight repairs.

PROPOSED OPERATIONS.

Future appropriations should be applied to repairing the jetties and to maintaining the channels already dredged. A recent estimate places the cost of properly repairing the jetties at about \$2,500. Nothing will be needed for maintaining the channel during the ensuing year.

Appropriations for Milford Harbor have been made as follows, viz:

Date.	Appropriations.	Amount.
June 10, 1872	Survey	\$1,500
June 23, 1874	Jetties on east shore	5,000
Mar. 2, 1875	Long Jetty and dredging at mouth of river	13,000
June 18, 1878	Dredging to Town Wharf	10,000
June 14, 1880	Dredging above Town Wharf and 8 feet below Merwin's Wharf on bar	5,000
Mar. 3, 1881	Survey for breakwater	100
Aug. 2, 1882	Dredging 8 feet on bar	5,000
Aug. 11, 1888	Dredging 8 feet on bar and repairing Long Jetty	5,000
	Total	44,000

Milford Harbor is in the collection district of New Haven; it is about 9 miles west from Fort Hale, New Haven Harbor. The nearest light-house is on Stratford Point, 4 miles to the westward.

Money statement.

July 1, 1888, amount available.....	\$241. 02
Amount appropriated by act of August 11, 1888.....	5, 000. 00
	<hr/> 5, 241. 02
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$2, 214. 89
July 1, 1889, outstanding liabilities.....	1, 621. 78
	<hr/> 3, 836. 67
July 1, 1889, balance available.....	1, 404. 35
<hr/>	
{ Amount (estimated) required for completion of existing project.....	2, 500. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	2 500. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in Milford Harbor, Connecticut, opened December 13, 1888, by Col. D. C. Houston, Corps of Engineers.

No.	Name and address of bidder.	Rate per cubic yard. (18,000 cubic yards).	Amount of bid.
		<i>Cents.</i>	
*1	Hartford Dredging Company, Hartford, Conn.....	18	\$3, 240
2	John H. Fenner, Jersey City, N. J.....	20	3, 600

* Lowest bid; entered into contract February 4, 1889; contract completed June 21, 1889.

NOTE.—Amount available for contract work, \$4,500.

COMMERCE OF MILFORD HARBOR, CONNECTICUT, FOR YEAR ENDING DECEMBER 31, 1888.

Vessels arriving and departing.

Vessels.	Number.	Tonnage.
Steamers	1, 006	114, 800
Sail-vessels	310	11, 729
Total	1, 976	128, 529

The chief articles of commerce are :

Coal (2,500 tons).....	\$11, 250
Lumber.....	25, 000
Oysters shipped (128,000 bushels)	96, 000
General merchandise.....	50, 000
Fish-oil and fertilizers.....	not known.

Most of the coal is now transported by rail.

D 8.

IMPROVEMENT OF HOUSATONIC RIVER, CONNECTICUT.

The Housatonic is a long shallow river, running southward through Massachusetts and Connecticut and emptying into Long Island Sound just east of Stratford Point, about 15 miles southwest from New Haven. At Derby, 13 miles above its mouth, it receives the discharge of the Naugatuck, a small rapid river. This point, which has been regarded

as the head of navigation, is nearly the head of tide-water. About a mile above there is a dam across the Housatonic River furnishing large water-power. For at least 5 miles below Derby the water is always fresh.

The original depth on the worst bars in the river (six in number) was from 3.5 to 4.5 feet at mean low water; there was also a bar across the river's mouth with about 4 feet low-water depth.

PROJECTS FOR IMPROVEMENT.

In pursuance of a resolution of the House of Representatives, dated December 20, 1869, authorizing a survey of the Housatonic River below Derby, which resolution was referred by the Secretary of War to the Chief of Engineers for report as to "the necessity for the survey," an examination of the river from Derby to Long Island Sound was made by Col. D. C. Houston, Corps of Engineers, who reported January 8, 1870, recommending a detailed survey of all that part of the river at an estimated cost of \$5,000.

This report was printed in House Ex. Doc. No. 62, Forty-first Congress, second session.

By act of Congress approved July 11, 1870, a survey of the Housatonic River below Derby, Conn., was directed, and an allotment of \$2,700 was made for a survey "sufficient to determine the prominent obstructions to navigation." In his report on this survey, dated January 23, 1871, and printed in House Ex. Doc. No. 95, Forty-first Congress, third session, also in the Annual Report of the Chief of Engineers for 1871, page 781. General G. K. Warren, Corps of Engineers, submitted the following estimates for making a channel 7 feet deep at mean low water, to be 200 feet wide over the bar at the mouth of the river, and 150 feet wide in the river, the channel at the river's mouth to be protected on the east side by a breakwater from Milford Beach:

Jetty at Sow and Pigs Reef.....	\$4,000
Removing Drew's Rock, 357 cubic yards.....	2,000
Dredging inside the bar at the mouth.....	18,486
Dredging on the bar at the mouth.....	12,000
Construction of breakwater at mouth.....	368,475
Total	404,961

The breakwater was to be built of riprap up to 1½ feet above mean low water and of dimension stone above; it was to be 6 feet wide on top, rising to 11 feet above low water, and was to extend to the 6-foot curve, an estimated length of 4,200 feet.

March 3, 1871, the first appropriation for improvement of the river was made and work in accordance with the project was begun. In 1872 the project was modified to admit of a jetty connecting Drew's Rock with the west bank, instead of removal of the rock. This was done on the ground of economy and the jetty was built in 1872. The result has been to form a bar below the jetty, which required such frequent dredging that it was found expedient to remove the rock, as originally projected. This was done in 1887-'88.

Appropriations were not made in sufficient amount to warrant beginning the breakwater as originally designed, and in 1879 Colonel Barlow proposed to substitute for it a riprap jetty at an estimated cost of \$12,000. In 1882 the estimate was changed to \$20,250, the contemplated jetty being 6,000 feet long and rising only to low-water level. Such a jetty could subsequently be built higher, if necessary, and there seems no

doubt that this would have to be done before any useful effect could be realized. Therefore, in my annual report for 1887 (see Annual Report of the Chief of Engineers for 1887, Part I, page 607), I presented revised estimates for a breakwater, modifying the originally proposed method of construction to one for using riprap only, experience at harbors on Long Island Sound having shown this construction to be as durable as dimension-stone work and more economical.

At the same time estimates based on recent surveys were submitted for the dredging necessary to make the channel 7 feet deep with width of 200 feet at the mouth of the river and 100 feet above. The latter width was adopted in 1883, because, up to that time, the originally proposed width of 150 feet had never been obtained.

Following are the estimates for the breakwater and for dredging submitted in 1887:

For a breakwater 5,750 feet long, extending from Milford Beach 3,250 feet in a course about south-southeast, thence parallel with and 500 feet from the channel, 2,500 feet further to the 12-foot curve inside the bend to be built up to 3 feet above mean low water, top width 6 feet, side slopes 1 on 1; outside the bend to be built up to 6 feet above high water, top width 12 feet, outer slope 1 on 2, and inner slope 1 on 1	\$175,000
For dredging at the mouth of the river and at six bars in the river, 146,000 cubic yards, at 16 cents, with about 15 per cent. added for contingent expenses	27,000
Total	202,000

To which should be added about \$4,000 annually required for maintenance of the channels.

January 27, 1888, a letter further explaining the reasons for the new estimate for the breakwater was submitted to the Chief of Engineers, and was subsequently printed as Senate Ex. Doc. No. 103, Fiftieth Congress, first session, and also in the Annual Report of the Chief of Engineers for 1888, Part I, page 554.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1889.

The act of Congress of August 11, 1888, which appropriated \$35,000 for improving this river provided that \$25,000 of this amount "may be expended in commencing the construction of a breakwater at the mouth of said river."

Mr. H. J. Lewis, of Stratford, Conn., the owner of that part of Milford Beach (on the east side of the river's mouth) where it was designed to place the shore end of the breakwater, voluntarily deeded to the United States a strip of beach 50 feet wide and 130 feet deep to be used for the construction of the shore end of the breakwater.

This deed was accepted by the Department of Justice as sufficient for the purpose for which it was designed, and the deed is recorded in the office of the town clerk of Milford, Conn.

Proposals for commencing the construction of a riprap breakwater to extend southeastwardly from Milford Beach were received and a contract dated May 17, 1889, was entered into with William H. Norton, for delivering riprap granite and constructing the breakwater as required, at the rate of \$1.49 per ton. Arrangements have been made for beginning work under this contract early in July.

Ten thousand dollars of the appropriation being applicable to dredging, proposals for hire of dredging plant, crew, and necessary appurtenances were received, and on April 9, 1889, a contract was entered into with Richard Parrott to furnish plant, etc., as required, at the rate of \$8.50 per hour. Work under this contract is not yet begun.

PRESENT CONDITION OF IMPROVEMENT.

The present available depth on the several bars in the river and on the bar at the mouth of the river is from 5 to 6 feet at mean low water. Drew's Rock and Jetty have been removed.

PROPOSED OPERATIONS.

Under the contracts now in force the channels in the river will be dredged to 7 feet depth at mean low water and the shore end of the breakwater will be constructed.

With future appropriations it is proposed to widen and maintain the river channels, to complete the breakwater, and to deepen and maintain the channel on the bar at the river's mouth, as provided in the project.

The estimated cost of completing this work is \$167,000, to which should be added about \$4,000 annually for maintenance of dredged channels.

Appropriations for the Housatonic River have been made as follows, viz:

Date.	Application.	Amount.
Mar. 2, 1867	Examination	\$42
July 11, 1870	Survey	2,700
Mar. 8, 1871	Sow and Pig's jetty; dredging	15,000
June 10, 1872	Drew's Rock jetty; dredging	15,000
Mar. 3, 1873	Dredging	10,000
June 23, 1874	do	10,000
Mar. 8, 1875	do	5,000
June 18, 1878	do	5,000
June 14, 1880	do	2,000
Mar. 3, 1881	do	2,000
Aug. 2, 1882	Removing Drew's Rock and jetty, 1887	2,000
July 6, 1884	do	2,500
Aug. 5, 1886	do	5,000
Aug. 11, 1888	Commencing breakwater; dredging	35,000
	Total	111,242

The Housatonic River is the boundary between the collection districts of New Haven and Fairfield. The nearest work of defense is Fort Hale, New Haven Harbor, about 15 miles east. The nearest light-house is on Stratford Point at the mouth of the river.

Money statement.

July 1, 1888, amount available	\$1,705.41
Amount appropriated by act of August 11, 1888	35,000.00
	<hr/> 36,705.41
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$614.23
July 1, 1889, outstanding liabilities	100.00
July 1, 1889, amount covered by existing contracts	27,860.00
	<hr/> 28,574.23
July 1, 1889, balance available	<hr/> 8,131.18

{ Amount (estimated) required for completion of existing project	167,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	100,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867	

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Abstract of proposals for hire of dredging plant for improving Housatonic River, Connecticut, opened March 13, 1889, by Col. D. C. Houston, Corps of Engineers.

No.	Name of bidder.	Rate per hour.	Guaranteed rate of excavation per hour.	Remarks.
*1	Richard Parrott, Newburgh, N. Y.....	\$8.50	<i>Qu. yds.</i> 50	17 c nts per cubic yard.
2	J. H. Fenner, Jersey City, N. J.....	11.00	60	18½ cents per cubic yard.

* Entered into contract with Richard Parrott, under date of April 9, 1889; work not yet begun.

NOTE.—Amount available for contract, \$9,000.

Abstract of proposals for the construction of breakwater at the mouth of the Housatonic River, Connecticut, opened April 22, 1889, by Col. D. C. Houston, Corps of Engineers.

No.	Name of bidder.	Rate per ton for riprap (14,000 tons).	Amount of bid.	Remarks.
1	John C. Fogg and Herbert H. Scribner, jr., New York City.....	\$2.43	\$34,720	Kind of stone, granite or black rock.
2	J. S. Howell, New York City.....	1.77	24,780	Kind of stone not stated.
*3	Wm. H. Morton, New York City....	1.49	20,860	Kind of stone, granite, verbal. Same rate as bid No. 4.
4	Francis H. Smith, New York City..	1.49	20,860	Kind of stone not stated. Same rate as bid No. 3.

* Entered into contract with Wm. H. Morton, under date of May 17, 1889; work about to begin.

NOTE.—Amount available for contract work, \$20,000.

COMMERCE OF HOUSATONIC RIVER FOR YEAR ENDING DECEMBER 31, 1883.

At Derby, head of navigation.

Vessels arriving and departing.	Number.	Tonnage.
Steamers	612	130,356
Sail vessels.....	844	84,460
Total	1,456	214,756

Articles.	Quantity.	Value.
Lumber received and shipped.....feet..	2,000,000	\$36,000
Coal received.....tons..	40,000	210,240
Copper received and shipped.....do..	8,000	210,480
Paper received and shipped.....do..	60,000	34,000
Iron received and shipped.....do..	12,000	228,000
Miscellaneous merchandise received.....do..	118,000	13,000,000
Miscellaneous merchandise shipped.....do..	50,000	6,700,000
Total		20,468,640

At Stratford, near mouth of river.

Vessels arriving and departing.		Tonnage.
Large vessels (steamers and sail vessels).....		2,780
Small vessels, "oystermen" (sail vessels).....		13,000

Articles.	Received.	Shipped.
	Tons.	Tons.
Coal	18,000	12,500
Oysters	5,000	5,000
Miscellaneous	10,700	28,770
Oyster shells.....	15,000	15,000
Total.....	48,700	61,270

The value of cargoes received and shipped was \$844,700.

D. 9.

IMPROVEMENT OF BRIDGEPORT HARBOR, CONNECTICUT.

This harbor extends nearly 3 miles inland from the north shore of Long Island Sound, its width of about one mile at the mouth decreasing to 200 feet between opposite wharves at its upper end. The channel even in the widest part of the harbor is comparatively narrow.

Before the first work by the United States was done at this harbor, the depth over the bars, at the harbor's mouth, was about 5 feet at low water, equivalent to 11½ feet at high water, and the low-water depth above the bridges was from 2 to 7 feet.

PROJECTS FOR IMPROVEMENT.

In 1833 a petition of citizens of Bridgeport was presented to Congress asking an appropriation of \$10,000 to improve the harbor; this was granted in 1836, and the agent in charge was instructed by the Engineer Department to dredge a channel 8 feet deep, making it 200 feet wide through the outer bar and 100 feet wide through the inner bar, or as much as the appropriation would admit of; the work was done by contract in 1837; the rate was high (understood to be 72.8 cents per cubic yard) and the funds were exhausted when the channel through the outer bar had been made 60 feet wide.

In 1838 Captain Swift, U. S. Engineers, reported that the channel had been sounded and was found to be 12 feet deep, or 4 feet deeper than when left by the dredger.

Nothing further was done until 1852, when a second appropriation of \$10,000 was made; Captain Dutton, U. S. Engineers, found that the channel on the outer bar was then 6 feet deep and 90 feet wide, and on the inner bar but 5 feet deep, and he submitted a project for dredging through both bars to a depth of 8 feet and a width of 200 feet, at a total estimated cost of \$32,000; this project was approved by the Secretary of War, February 5, 1853, and with the \$10,000 then available, channels 8 to 13 feet deep were dredged 100 feet wide through the inner bar and 60 feet wide through the outer bar.

The project of 1882 for making 600 feet width of channel between the inner beacon and the Naugatuck Railroad Wharf was reported in the last Annual Report as completed.

The inner beacon has been rebuilt and its location slightly changed, which makes it desirable to cut off a shore point outside the new position of that beacon; this was partly done in 1888.

PROPOSED OPERATIONS.

With future appropriations it is proposed to complete the channel above the bridges, to remove the shoal places above the Naugatuck Railroad Wharf, and to widen the channel eastward to the harbor line an additional width of about 200 feet; also to construct a breakwater from the tongue to the inner beacon. The estimated cost of the above work is \$55,000; it could be done to advantage in a single year.

The annual cost of maintaining the dredged channels in this harbor is estimated at \$3,000.

Appropriations for the improvement of Bridgeport Harbor have been made as follows, viz:

Date.	Application.	Amount.
July 4, 1836	Dredging outer bar	\$10,000.00
Aug. 30, 1852	Dredging outer and inner bars.....	10,000.00
June 23, 1866	Survey	1,985.38
July 11, 1870	.....do	500.00
Mar. 3, 1871	Dredging and 521 feet of breakwater	20,000.00
June 10, 1872	Dredging and 859 feet of breakwater	40,000.00
Mar. 3, 1873	Dredging inner bar and upper harbor	30,000.00
June 23, 1874	Dredging, bridge to Long Island Sound (9 feet).....	20,000.00
Mar. 3, 1875	Dredging, bridge to Long Island Sound (12 feet).....	15,000.00
Aug. 14, 1876	Dredging upper harbor (9 feet).....	10,000.00
June 18, 1878	Dredging above bridge and outer bar (9 and 12 feet).....	10,000.00
Mar. 3, 1879	Dredging, bridge to Long Island Sound (12 feet).....	10,000.00
June 14, 1880	.....do	10,000.00
Mar. 3, 1881	Dredging above inner beacon (12 feet).....	10,000.00
Aug. 2, 1882	Dredging between inner beacon and railroad wharf (12 feet).....	10,000.00
July 5, 1884	.....do	5,000.00
Aug. 5, 1886	.....do	20,000.00
Aug. 11, 1888	Dredging above horse-railroad bridge (9 feet).....	10,000.00
	Total	\$42,485.38

Bridgeport, the port of entry for the collection district of Fairfield, is situated about 2 miles from Long Island Sound, at the head of Bridgeport Harbor. There is a light-house at the entrance to the harbor. Fort Hale, New Haven Harbor, the nearest work of defense, is 18 miles east.

Money statement.

July 1, 1888, amount available.....	\$197.06
Amount appropriated by act of August 11, 1888	10,000.00
	10,197.06

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$1,418.41
July 1, 1889, outstanding liabilities.....	5,269.50
July 1, 1889, amount covered by existing contracts.....	1,070.28
	7,758.19
July 1, 1889, balance available.....	2,438.87

{ Amount (estimated) required for completion of existing project	55,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	55,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867..	

BANKS

CITY OF BRIDGEPORT.



The project of 1882 for making 600 feet width of channel between the inner beacon and the Naugatuck Railroad Wharf was reported in the last Annual Report as completed.

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{ Amount that can be profitably expended in fiscal year ending June 30, 1891	55,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867	

BRAND

CITY OF BRIDGEPORT.



Abstract of proposals for dredging in Bridgeport Harbor, Connecticut, opened December 13, 1888, by Col. D. C. Houston, Corps of Engineers.

No.	Name and address of bidder.	Rate per cubic yard (40,000 cubic yards).	Amount of bid.
		<i>Cents.</i>	
1	Hartford Dredging Company, Hartford, Conn.....	23½	\$9,400
2	Elijah Brainard, New York City.....	26	10,400
*3	A. J. Beardsley & Son, Bridgeport, Conn.....	18	7,200

*Lowest bid; entered into contract February 4, 1889. In progress.

NOTE.—Amount available for contract work, \$9,000.

COMMERCIAL STATISTICS FOR CALENDAR YEAR OF 1888.

	No.	Tonnage.
Foreign commerce:		
Arrivals.....	11	1,827
Departures.....	9	1,249
Domestic commerce, arrivals and departures.....	17,060	1,265,780

Estimated value of cargoes.

Receipts.....	\$41,000,000
Shipments.....	40,000,000

Vessels arriving and departing.

[Draught 6 to 18 feet.]

Steamers.....	5,160
Sailing vessels.....	6,100
Barges.....	5,800
Total.....	17,060

Vessels carrying 212,000 tons of coal entered the harbor for refuge during 1888.

PETITION RELATING TO DREDGING ABOVE BRIDGES.

To the honorable SECRETARY OF WAR:

The undersigned dock and property owners and citizens of the city of Bridgeport between the horse railroad bridge and the Berkshire Mills, on the harbor of said city, respectfully represent that while large appropriations have been made by Congress from time to time, to improve Bridgeport Harbor, not one dollar has been expended above the horse railroad bridge, and all improvements made have been by private enterprise. A large amount of business is now transacted, which would be soon four folded with reasonable facilities.

A moderate outlay in cutting off some points of mud flats would straighten the course of the water, give a direct flow, and remove the eddies which now fill up the channel. By deepening, the straightened channel (which is all mud) would not only give us the same advantages for water traffic as enjoyed below us, but would also help to clean out the channel to the mouth of the harbor by the unobstructed flow of water, at low tide, from the mills above.

We can not now reach our docks only at full tide, with from 7 to 8 feet of water, which is a serious detriment to our business. We are often delayed for hours, and even days, on account of the tides.

We, therefore, representing the amount of yearly business and water front affixed to our names, and other interested citizens, most respectfully petition and ask for an

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appropriation of \$10,000, that the above-named channel may be opened 8½ to 9 feet deep, and 100 feet in width.

Names.	Capital.	Water front.
		<i>Feet.</i>
Civilion Fones, mayor.....		
Walter Goddard, collector of customs.....		
John McNeal, harbor master.....		
P. T. Barnum, per B.....		300
David M. Reid, president Board of Trade.....		
F. Armstrong.....	*\$100,000	000
The Water Wheel Company.....	50,000	
The W. F. Swords Lumber Company.....	100,000	200
The Bridgeport Gas-Light Company.....		400
George W. Hayes.....		802
The Acme Star. Company.....	60,000	
A. L. Winston.....	(†)	775
Berkshire Store and Coal Company (receive 3,000 to 5,000 tons coal).....		
Berkshire Flour and Feed Mills (occupying 300 feet dock).....		
J. A. Blank (tonnage, 6,000 to 8,000 tons).....	50,000	400
F. W. Parrott.....		000
The Bridgeport Spring Company.....	100,000	
Mills & Burritt.....	75,000	
Parrott Varnish Company.....	350,000	
The Bridgeport Paper Company, Nelson Curtis, treasurer.....	500,000	
Naugatuck Valley Ice Company.....		
Honastonic Ice Company, G. T. N.....		

*About.

†\$100,000 to \$150,000.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
December 21, 1887.

Respectfully referred to Lieut. Col. D. C. Houston, Corps of Engineers, for report.

To be returned.

By command of Brig. Gen. Duane.

JAS. C. POST,
Major of Engineers.

[Second indorsement.]

ENGINEER OFFICE, U. S. ARMY,
New York, January 19, 1888.

Respectfully returned to the Chief of Engineers with report of this date.

D. C. HOUSTON,
Lieut.-Col. of Engineers.

REPORT OF COLONEL D. C. HOUSTON, CORPS OF ENGINEERS.

NEW YORK, January 19, 1888.

SIR; I have the honor to submit the following report on the accompanying petition of citizens of Bridgeport, Conn., asking an appropriation of \$10,000 for improving the channel at Bridgeport Harbor, above the horse-railroad bridge.

I forward a tracing showing the locality referred to. The general project for the improvement of this harbor has consisted in deepening the channel from Long Island Sound to the lower bridge, and in widening part of this channel to afford nearer anchorage ground and a harbor of refuge for vessels navigating the Sound. The estimate of \$17,000, submitted in my last annual report, is made under this project.

The only work which has been done above the lower bridge by the United States was in 1878. A communication, dated March 20, 1878,

was addressed to Maj. J. W. Barlow, Corps of Engineers, by citizens of Bridgeport, asking in substance that the project be extended so as to allow dredging up to the horse-railroad bridge, and stating that "the traffic above said bridge is insignificant, and will not justify or require any expenditure at present." Major Barlow forwarded this petition to the Chief of Engineers, with a favorable report.

The Chief of Engineers, in a letter dated April 2, 1878, replied as follows:

The dredging asked for not being included in the plan adopted by Congress for the improvement of the harbor for which appropriations have been made can not be undertaken until a survey is made of the locality upon which to base a plan and estimate of cost.

There is no authority in this office to direct such a survey, and there are no funds available for the purpose. It is, therefore, suggested that the parties interested correspond upon the subject with their Representative in Congress, with a view to having a survey provided for in the new river and harbor act.

The next river and harbor act, approved June 18, 1878, did not provide for a survey, but appropriated \$10,000 for "Improvement of Bridgeport Harbor," of which sum not less "than one-half shall be expended between the lower bridge and the horse-railroad bridge."

In the fall of 1878 a channel was dredged from the lower bridge to the horse-railroad bridge, as shown on the accompanying tracing. The same reasons that called for this improvement in 1878 now exist for extending it above, as the traffic above the bridge has largely increased.

Since 1878 the Armstrong Manufacturing Company has built a large factory above the horse-railroad bridge; the Wales Wheel Company, the Acme Shear Company, Mills & Burritt, and others whose names are signed to the accompanying petition, have located there, and have need of better water-privileges.

During the past year the draw of the horse-railroad bridge was opened about three hundred times for vessels; 2,500,000 feet of lumber, 29,300 tons of coal, and miscellaneous freight not recorded came through the draw in about 138 cargoes. Draught of vessels ranges from 7 to 9 feet and tonnage from 50 to 500 tons.

The tracing shows the docks and other improvements above the horse-railroad bridge, but it gives no soundings. Only an approximate estimate of the cost of the desired improvement can be made. It is believed that the sum of \$15,000 will be sufficient to excavate a channel 100 feet wide and 9 feet deep at low water from the bridge up to the mill-dam, which is the head of navigation. To make this channel available, the channel below, which has shoaled and narrowed since 1878, should be made of the same width and depth as above; the estimate for this is \$3,000, making a total of \$18,000.

Should Congress authorize this work the estimate for the next fiscal year should be correspondingly increased, and provision made for expending the amount necessary between the lower bridge and the Berkshire Mills.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

PETITION RELATING TO BREAKWATER FROM THE TONGUE TO THE INNER BEACON.

BRIDGEPORT, *March 8, 1889.*

Your petitioners respectfully represent the necessity of an inner breakwater, or riprap, for the harbor of Bridgeport, Conn., extending from the point of the Tongue (so-called), being the easternmost point of land on the shore of the Sound, east of the Seaside Park, thence easterly about 1,500 feet to the inner beacon, for the protection of vessels lying at anchor in the harbor, running in for refuge, or at the docks, from the southerly or southeast gales, which prevail up Long Island Sound from the Atlantic Ocean.

Large new docks have been recently erected near the mouth of the harbor, which are exposed to these gales, rendering wharfage out of the question, and the same trouble exists at the docks all along up to a half a mile above on both sides of the harbor.

The wearing away of the beach at this point will be stopped by this method, and save large additional expense, if the work is done now and not longer delayed.

The entire commerce of the Sound is interested in this work.

Your petitioners earnestly request your action, and as in duty bound will ever pray.

PATRICK COUGHLIN, *Mayor* (and 27 others).

Hon. REDFIELD PROCTOR,
Secretary of War.

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
March 18, 1889.

Respectfully referred to Lieut. Col. D. C. Houston, Corps of Engineers, for report.

H. M. ADAMS,
Major, Corps of Engineers,
In Charge.

[Third indorsement.]

ENGINEER OFFICE, U. S. ARMY,
New York, March 23, 1889.

Respectfully returned to the Chief of Engineers, with tracing of Bridgeport Harbor.

The purpose of the petition is to secure breakwater extending E. SE. from "the Tongue" to, or nearly to, the "inner beacon," a distance of about 1,100 feet.

The location is about 3,000 feet above the harbor light-house or nearly half way from the light-house to the lower bridge.

Bridgeport Harbor is open to the southward, and it is represented that the anchorage ground dredged between the inner beacon and the Naugatuck Wharf is so rough in southerly storms that the barges and small vessels will not lie there, but haul up above the Naugatuck Wharf, where the channel is not wide enough for convenient anchorage room. The same seas prevent the use of the south side of the Naugatuck Wharf and of the small wharves opposite in southerly winds.

Above the Naugatuck Wharf the water is always still.

To build a breakwater from "the Tongue" to the inner beacon 5 feet wide on top and 3 feet above high water would require about 15,000 tons of stone, costing (on account of shoal water) \$1.75 per ton; allowing about 15 per cent. for contingencies, the total cost would be about \$30,000.

The present and increasing commerce of Bridgeport requires that the harbor should ultimately be improved to its full capacity. The improvement now consists of a channel 300 feet wide and 12 feet deep at mean low water from the Sound to the lower bridge, with a 100-foot chan-

nel nearly 9 feet deep extending to the upper or horse-railroad bridge; it is also proposed this season to extend the 9-foot channel up to Berkshire Mills, about a half mile farther.

The channel between the inner beacon and the Naugatuck Railroad Wharf has been widened to 600 feet for a length of 3,000 feet, with a depth of 12 feet at mean low water, to afford a harbor of safety for vessels and tows navigating the Sound, which harbor is extensively used.

If a breakwater is to be constructed on the west side of the harbor, I am of the opinion that it should extend from the shore to the light-house, as shown in red on the tracing, instead of from the "Tongue" to the inner beacon," as shown in blue. The cost of such a work, as nearly as can be estimated from existing data, would be as follows:

A wall extending from the shore to the light-house, a distance of 2,100 feet, to be built of riprap to a height of 9 feet above mean low water, with a top width of 7 feet, and with side slopes of 1 upon 1, to be covered with a capping of rough dimension stone, placed as a course 6 feet wide and two feet high, would require:

23,700 tons of riprap, at \$1.40 per ton	\$40, 180
933 cubic yards of capping, at \$13	12, 129
Contingent expenses about 15 per cent.....	7, 691
Total estimated cost	60, 000

This would accomplish the object of the petition and would greatly increase the area which could be improved for the benefit of commerce. In my opinion, the importance of the harbor would justify this expenditure.

It may also be advisable at some future time to extend the breakwater on the east side of the harbor; it was originally designed to be 3,000 feet long, but only 1,380 feet have been built. Work upon it was suspended in 1873 because it appeared that the pressing needs of commerce could be better met by applying the available funds to dredging, and as a further protection did not prove necessary to maintain the dredged channels, the breakwater has not since been extended. There are no funds available for a breakwater on the west side of the harbor. The estimates submitted in the annual report for 1888 were for dredging. The last river and harbor act of August 11, 1888, appropriated \$10,000 for continuing improvements of Bridgeport Harbor, and provided that the Secretary of War might "expend such portion of said sum as he may deem advisable above the bridges across the stream emptying into said harbor."

D. C. HOUSTON,
Lieut. Col. of Engineers.

[Fourth indorsement.]

ENGINEER OFFICE, U. S. ARMY,
New York, May 8, 1889.

Since writing the above indorsement I had occasion to visit Bridgeport, and, at my request, the petition was returned for further consideration with letter from the Chief of Engineers, dated March 29, 1889. The result of this visit was to confirm my views as to the importance of this harbor, and the necessity of further improvements, but to modify them as to the location of a western breakwater. I am still of the opinion that the construction of a breakwater from the shore to the light-house, with the extension of the eastern breakwater, would constitute a

more complete improvement than the one from the tongue to the inner beacon; but the citizens interested prefer the latter, which would undoubtedly accomplish the object they have in view, and would cost much less than the plan I suggested.

The only portion of the harbor which is now used both for vessels seeking refuge and for local purposes is above the inner beacon, and this below the Naugatuck Railroad Wharf (with the wharf on the east side); is very much exposed during southerly and southwesterly winds. The west shore south of the tongue is occupied as a public park, and can not be utilized for the construction of wharves.

The construction of a breakwater from the tongue to the inner beacon with the future extension of the eastern breakwater will effectually protect the portion of the harbor now used, and answer all requirements for many years. I would therefore report favorably on the request made by the citizens, and, if approved, will submit estimates for the needed works in my next annual report.

Respectfully submitted.

D. C. HOUSTON,
Lieut. Col. of Engineers.

[Fifth indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
May 11, 1889.

Respectfully returned to Lieut. Col. D. C. Houston.

It is suggested that it would be well to notice this subject in his next annual report, and include estimates.

To be returned.

By command of Brig. Gen. Casey:

H. M. ADAMS,
Major, Corps of Engineers.

[Sixth indorsement.]

ENGINEER OFFICE, U. S. ARMY,
New York, May 16, 1889.

Respectfully returned to the Chief of Engineers, records of all indorsements having been made.

D. C. HOUSTON,
Lieut. Col. of Engineers.

D 10.

IMPROVEMENT OF BLACK ROCK HARBOR, CONNECTICUT.

This harbor, $1\frac{1}{2}$ miles long from northeast to southwest and from 300 to 2,500 feet wide, lies between the mainland on the west and Fair-weather Island on the east, and includes the navigable part of Cedar Creek, a small tidal inlet which extends up into the western part of the city of Bridgeport, and affords water communication of great value to several large manufactories in its immediate neighborhood. It is in the interest of the city of Bridgeport that the improvement of Black Rock Harbor is desired.

The depth in the lower part of the harbor is from 6 to 12 feet at mean low water. This part of the harbor was formerly much used as a refuge

for vessels overtaken by storms, but it is not deep enough for most vessels now engaged in commerce through the Sound. Before work was done in Cedar Creek the depth there was from 2 to 4 feet and the channel was narrow and crooked.

The head of the harbor was separated from Long Island Sound on the southeast by a broad, flat sand-bar, which was bare at about half-tide, and which joined Fairweather Island with the main shore.

PROJECTS FOR IMPROVEMENTS.

Between 1836 and 1838, \$21,500 were expended in building a sea-wall across a breach in the southern part of Fairweather Island to preserve the light-house reservation at the south end of the island, and to prevent shoaling on the anchorage-ground.

In 1882 a survey of the harbor was ordered by Congress, which was made in 1883. In his report on this survey, dated December 12, 1883, and printed in Senate Ex. Doc. No. 50, Forty-eighth Congress, first session; also in the Annual Report of the Chief of Engineers for 1884 (Part I, page 666), Colonel McFarland, U. S. Engineers, submitted a project providing—

(1) For protecting the upper part of the harbor from the sea by building a breakwater over the bar northeast of Fairweather Island, to be about a half mile long and 6 feet wide at the top, which was to be 3½ feet above mean high water, or 10 feet above low water.

(2) For making a channel 80 feet wide and 6 feet deep at mean low water, extending up Cedar Creek.

The estimated cost was:

Breakwater.....	\$58,000
Dredging.....	22,000
Total	80,000

Work under this project was begun in 1885, and up to July 1, 1888, the breakwater had been built to its full length in order to prevent the currents from cutting a channel across the bar, but its cross-section was less than designed, both in height and width; also a channel 6 feet deep, or over, had been dredged with width of 60 feet up to the forge company's wharf in Cedar Creek, and extended about 430 feet farther, with a width of 30 to 40 feet.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1889.

The act of Congress of August 11, 1888, appropriated \$10,000 for continuing this improvement. Proposals were received, and under date of April 23, 1889, a contract was entered into with J. H. Fenner, of Jersey City, N. J., to do the required dredging, at the rate of 16 cents per cubic yard. Work under this contract is to begin early in July.

PRESENT CONDITION OF IMPROVEMENT.

The sea-wall built in 1836-'38 across a breach in Fairweather Island is still effective in preserving the island and in preventing the sea from washing over into the harbor. It needs some repair.

The breakwater between Fairweather Island and the mainland is built to its full length, 2,744 feet, with diminished cross section.

The 6-foot channel has been dredged to the full width projected (80 feet), but that part dredged in 1884 has shoaled nearly 2 feet, so that

the present available width is but 60 feet; it extends up the harbor to a point opposite the Forge Company's Wharf.

PROPOSED OPERATIONS.

With future appropriations it is proposed to complete the channel to its projected width of 80 feet, to extend it up the harbor, and to build up the breakwater to the dimensions projected; \$20,000 could be profitably expended on the work during the next fiscal year.

Appropriations for the improvement of Black Rock Harbor have been made as follows, viz:

Date.	Application.	Amount.
1836-'38.....	Building sea-wall in Fairweather Island	\$21,500
Aug. 2, 1882	Survey	200
July 5, 1883	Building breakwater and dredging	20,000
Aug. 6, 1886	Dredging	5,000
Aug. 5, 1888	Dredging (not yet expended)	10,000
	Total	56,850

Black Rock Harbor is in the Fairfield collection district, of which Bridgeport is the port of entry. There is a light-house at the harbor entrance. Fort Hale, New Haven Harbor, the nearest work of defense, is 20 miles east.

Money statement.

July 1, 1888, amount available	\$140.30
Amount appropriated by act of August 11, 1888.....	10,000.00
	<hr/> 10,140.30
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$55.74
July 1, 1889, amount covered by existing contracts.....	8,000.00
	<hr/> 8,055.74
July 1, 1889, balance available.....	<hr/> 2,084.56
{ Amount (estimated) required for completion of existing project.....	45,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	20,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in Black Rock Harbor, Connecticut, opened March 13, 1889, by Col. D. C. Houston, Corps of Engineers.

No.	Name and address of bidder.	Rate per cubic yard (50,000 cubic yards).	Amount of bid.
		Cents.	
1	Brainerd Bros., New York City.....	28	\$14,000
2	Henry Dubois' Sons, New York City.....	22½	11,250
3	J. H. Fenner, Jersey City, N. J.....	16	8,000

*Lowest bid.

NOTE.—Amount available for contract \$9,000.

Abstract of contract for improving Black Rock Harbor, Connecticut, in force during fiscal year ending June 30, 1889.

Name and address of contractor.	Date.	Subject.	Price per cubic yard.	Remarks.
J. H. Fenner, Jersey City, N. J	April 23, 1889.	Dredging.	Cents. 16	Work not yet begun.

COMMERCIAL STATISTICS.

The amount of coal, iron, steel, etc., received in Black Rock Harbor during the calendar year 1888 was 27,500 tons; an equal or greater amount is now carted from Bridgeport Harbor, which would be shipped direct to Black Rock if the channel were sufficiently extended.

D II.

IMPROVEMENT OF NORWALK HARBOR, CONNECTICUT.

Norwalk Harbor or River is a tidal estuary, with a narrow channel extending about 3 miles north from Long Island Sound to the town of Norwalk. Above Norwalk the river is a small fresh-water stream. South Norwalk is on the west bank of the river, $1\frac{1}{4}$ miles below Norwalk. At this point the river is crossed by two bridges, the lower one a wagon bridge and the other (450 feet above) the bridge of the New York, New Haven and Hartford Railroad.

In 1867 a company was incorporated under the laws of the State of Connecticut for the improvement of this river. Little work was done, and when the improvement was begun by the United States the low-water depth to South Norwalk was 5 feet and to Norwalk but 1 foot.

PROJECTS FOR IMPROVEMENT.

By act of March 2, 1829, Congress appropriated \$80 "for making a survey of the harbor of Norwalk, Conn., with a view to its improvement."

The survey was made by Capt. Hartman Bache, U. S. Engineers, who, in his report on the same, dated May 10, 1830, recommended excavating the channel, proposing to build a steam-dredge for the purpose, to cost—

For a channel 12 feet deep at ordinary high water.....	\$15,668.85
For a channel 10 feet deep at ordinary high water.....	12,286.45

No money was appropriated for carrying out this plan, and in 1871 another survey was ordered by Congress, which was made in the same year. In his report upon the latter survey, dated December 16, 1871, and printed in Senate Ex. Doc. No. 23, Forty-second Congress, second session, also in the Annual Report of the Chief of Engineers for 1872, page 900, General Warren, U. S. Engineers, submitted a project for dredging a channel 6 feet deep and 100 feet wide from Long Island Sound up to Norwalk at an estimated cost of \$34,000.

In 1880 the terms of the river and harbor act provided that "so much of said appropriation (\$5,000) as shall be necessary therefor shall be so expended as to have a channel 6 feet deep at low water between the

steam-boat landing in said Norwalk and Long Island Sound." As a channel of the projected width (100 feet) and depth of 6 feet at mean low water already existed, this was interpreted to require a depth of 6 feet at *extreme* low water (see Annual Report of the Chief of Engineers for 1881, Part I, page 609), which would be 8 feet at mean low water, and the project was accordingly modified to provide for obtaining that depth up to South Norwalk.

The latest estimate, made to include the cost of this modification and of a large amount of dredging already required to maintain the depths, places the total cost, from the time of beginning work, at \$84,000.

Up to July 1, 1888, the channel below South Norwalk had been dredged 100 feet wide and 8 feet deep at mean low water, but the width had somewhat diminished by washing in from the banks. Above South Norwalk the channel was from 60 to 100 feet wide and 6 feet deep at mean low water.

March 3, 1888, a letter was sent to the Secretary of War by the Hon. William P. Frye, United States Senator, asking that a special examination of Norwalk Harbor be made with reference to a developing business which urgently required a further improvement.

There was no money available for a detailed examination, but inquiry was made and estimates for the desired improvement (which consisted of dredging at Wilson's Point at the western approach to the harbor) were submitted, based upon charts of the United States Coast Survey. A copy of the letter to the Secretary of War, with indorsements, is appended.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1889.

By act of August 11, 1888, Congress appropriated \$28,000 for continuing the improvement of this harbor, with provision as follows:

Twenty-five thousand dollars of which shall be expended in dredging and deepening the channel in the lower harbor up to Wilson's Point.

Proposals were received for dredging in the river under the \$3,000 applicable to that work, and for dredging at Wilson's Point under the \$25,000 specially appropriated for such dredging.

Under date of January 15, 1889, a contract was entered into with Messrs. A. J. Beardsley & Son, of Bridgeport, Conn., for dredging at Wilson's Point, at the rate of 11 cents per cubic yard, and under date of February 4, 1889, a contract was made with the same parties for dredging in the river at the rate of 15 cents per cubic yard.

Work at Wilson's Point was begun January 15, and continued until April 20, 1889; 109,995 cubic yards of sand, mud, and clay had been dredged, making a channel 15 feet deep and 200 feet wide, extending about two-thirds the required distance.

The Housatonic Railroad Company, which controls all the commerce of the harbor, had done a large amount of dredging in the harbor, so that there was a channel to the wharves of fully 12 feet depth and 100 to 300 feet wide, before the Government work was begun. On this account further work was not immediately needed, and the contract was temporarily suspended, to be resumed early in July. In May, 1889, the depots, docks, and landings of the railroad company were almost totally destroyed by fire, and their freight terminus was transferred to Bridgeport. It is understood that the wharves will be rebuilt.

Under the contract for dredging in the river work was begun April 23, and completed May 6, 1889, 12,337 cubic yards of mud being removed in restoring the channel where it had narrowed from washing in

at the sides; 10,194 cubic yards of this amount were dredged from below South Norwalk, making 8 feet depth, and 2,143 cubic yards from above South Norwalk, making 6 feet depth.

PRESENT CONDITION OF IMPROVEMENT.

In the river the channel below South Norwalk, which has been dredged 100 feet wide and 8 feet deep, is in fair condition, the width being slightly less than projected on account of caving and washing of the banks. Above South Norwalk the channel is 6 feet deep and from 60 to 100 feet wide.

At Wilson's Point the channel close to the docks is 12 feet deep, dredged by the railroad company; outside of this is a channel also 12 feet deep and 100 feet wide, extending to the 12-foot curve, and dredged by the railroad company. East of the latter is a channel 200 feet wide and 15 feet deep, but as yet extending only to the 12-foot curve, dredged under the Government contract.

PROPOSED OPERATIONS.

Under the contract now in force it is proposed to complete the channel at Wilson's Point to 15 feet deep and 300 feet wide as originally desired. It is believed that this can be accomplished under the appropriation of \$25,000, as yet but partly expended. This is much less than the estimated cost, because of the large amount of work done by the railroad company since the date of the estimate and because of the unexpectedly low rates obtained. No further appropriation will be needed for Wilson's Point.

The estimated amount to complete work in the river is \$4,000. This could be advantageously expended in the ensuing year in restoring and maintaining the channels already dredged. It seems unnecessary and inexpedient to attempt to make and maintain a width of 100 feet above South Norwalk.

Appropriations for improving Norwalk Harbor have been made as follows, viz:

Date.	Application.	Amount.
Mar. 2, 1839	Survey	\$80.00
Mar. 3, 1871	do	1,108.00
June 10, 1872	Dredging (6 feet) above South Norwalk	10,000.00
Mar. 3, 1873	do	10,000.00
June 23, 1874	do	10,000.00
Mar. 3, 1875	Dredging (6 feet) below South Norwalk	7,000.00
June 13, 1878	do	6,000.00
Mar. 3, 1879	Dredging (6 feet) above and below South Norwalk	10,000.00
June 14, 1880	Dredging (6 feet) below South Norwalk	5,000.00
Mar. 3, 1881	Dredging (6 feet) below and (6 feet) above South Norwalk	5,000.00
Aug. 2, 1882	Dredging (6 feet) above South Norwalk	5,000.00
July 5, 1884	Dredging (6 feet) below South Norwalk	5,000.00
Aug. 5, 1885	Dredging (6 feet) above South Norwalk	3,000.00
Aug. 11, 1888	Dredging (6 feet) above and (8 feet) below South Norwalk, and \$25,000 in dredging 15 feet deep at Wilson's Point.	23,000.00
Total		105,246.00

Norwalk is in the Fairfield collection district, and is 11 miles west of Bridgeport, the port of entry. Norwalk light-house is on Sheffield's Island, at the harbor entrance. The nearest work of defense is Fort S. Huyler, at the head of Long Island Sound, 39 miles southwest.

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Money statement.

July 1, 1888, amount available.....	\$503.10
Amount appropriated by act of August 11, 1888.....	28,000.00
	<u>28,503.10</u>
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$14,153.13
July 1, 1889, outstanding liabilities.....	1,209.94
July 1, 1889, amount covered by existing contracts.....	3,300.55
	<u>18,663.62</u>
July 1, 1889, balance available.....	<u>9,839.48</u>
{ Amount (estimated) required for completion of existing project.....	4,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	4,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging at Wilson's Point, Norwalk Harbor, Connecticut, opened December 13, 1888, by Col. D. C. Houston, Corps of Engineers.

No.	Name and address of bidder.	Rate per cubic yard (140,000 cubic yards).	Amount of bid.
		<i>Cents.</i>	
1	Hartford Dredging Company, Hartford, Conn.....	18	\$28,280
2	Elijah Brainard, New York City.....	19½	27,500
3	John H. Fenner, Jersey City, N. J.....	17	23,800
4	P. Sanford Ross, Jersey City, N. J.....	15	21,000
*5	A. J. Beardale & Son, Bridgeport, Conn.....	11	15,400

NOTE.—Amount available for contract work, \$23,000.

*Lowest bid; entered into contract with A. J. Beardale & Son, under date of January 15, 1889. Contract still in force.

Abstract of proposals for dredging in Norwalk River, Connecticut, opened December 13, 1888, by Col. D. C. Houston, Corps of Engineers.

No.	Name and address of bidder.	Rate per cubic yard (12,000 cubic yards).	Amount of bid.
		<i>Cents.</i>	
1	Hartford Dredging Company, Hartford, Conn.....	16½	\$1,980
2	Elijah Brainard, New York City.....	21	2,520
*3	A. J. Beardale & Son, Bridgeport, Conn.....	15	1,800

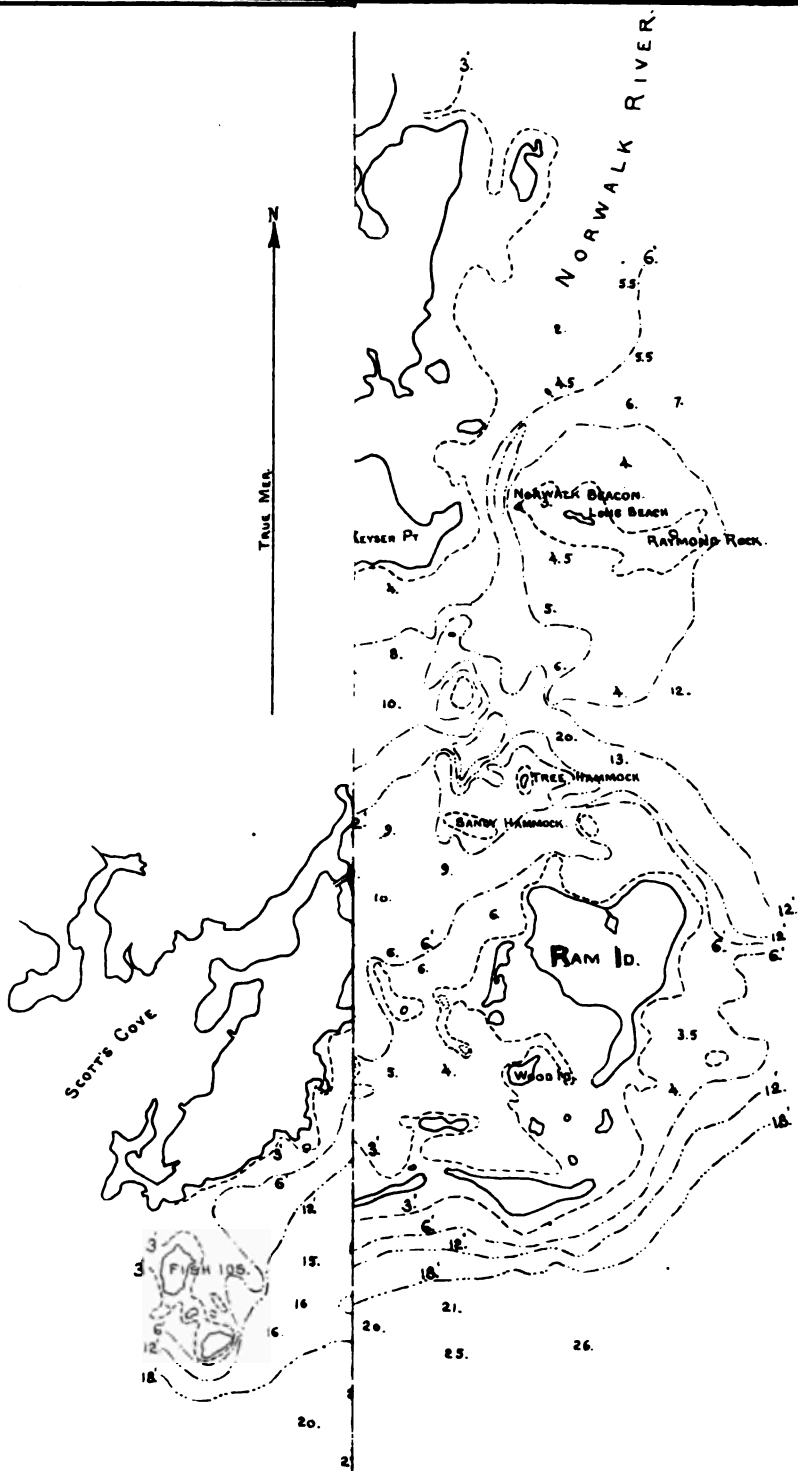
NOTE.—Amount available for contract work, \$2,500.

*Lowest bid; entered into contract with A. J. Beardale & Son, under date of February 4, 1889. Contract completed May 6, 1889.

COMMERCIAL STATISTICS.

No statement of commerce of the Norwalk River for 1888 is yet received; it is probably not far from that for 1886, when the receipts and shipments amounted to 433,600 tons, carried by 2,370 vessels of 9 to 10 feet draught.

The total amount of freight received and shipped at Wilson's Point during 1888 was 94,235 tons.



pany the Annual Report.

A. C. Houston

L O N

Colonel of Engineers.

LETTER FROM HON. WILLIAM P. FRYE, UNITED STATES SENATOR, TO
THE SECRETARY OF WAR.

SENATE CHAMBER,
Washington, D. C., March 3, 1888.

SIR: It is represented to the Committee on Commerce that on account of a developing business at Norwalk Harbor, in Connecticut, there is urgent need for a considerable appropriation for its immediate improvement. If practicable, the committee desires that a special examination of the harbor with reference to the necessity and cost of such improvement be made with as little delay as may be, and the result communicated to the committee, or to the Senate.

Very respectfully, yours, etc.,

WM. P. FRYE.

Hon. WM. C. ENDICOTT,
Secretary of War.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
March 8, 1888.

Respectfully referred to Lieut. Col. D. C. Houston, Corps of Engineers, for report. To be returned.

By command of Brig. Gen. Duane.

JAS. C. POST,
Major of Engineers.

[Second indorsement.]

ENGINEER OFFICE, U. S. ARMY,
New York, March 20, 1888.

Respectfully returned to the Chief of Engineers.

The present approved project for the improvement of Norwalk Harbor provides for dredging a channel from Long Island Sound to the wharves at Norwalk 100 feet wide, the depth to be 8 feet below South Norwalk, and 6 feet above that point.

The estimate of \$7,000 submitted in the Annual Report of the Chief of Engineers for 1887 is for the completion of that project.

It appears from personal interviews with citizens of Norwalk that no further improvement of Norwalk Harbor than this is desired at present. I am informed, however, that a petition has been sent to Congress asking for certain improvements at Wilson's Point on Long Island Sound, about $1\frac{1}{2}$ miles west of the entrance to Norwalk Harbor.

This point is a terminus of the Housatonic Railroad, and it appears from surveys by the Coast Survey (1885 and 1886) that a depth of 7 feet can be carried up to the railroad wharves.

The parties interested desire a depth of 15 feet.

This can be accomplished by extending the wharves out to that depth, or by excavating a channel about one-half a mile in length to a depth of 15 feet at mean low water from the wharf to the 15-foot curve. The surveys do not show any material that can not be removed by dredging.

The approximate cost of excavating such a channel to the desired width of 300 feet would be as follows:

230,000 cubic yards, at 20 cents	\$46,000
Contingencies, 15 per cent.	6,900
	<hr/>
	52,900

The location is partially protected by the Norwalk Islands, but not sufficiently to prevent the channel from filling by the action of storms. Periodical expenditures would be required for its maintenance. There does not seem to be any objection to extending the wharves out to the 15-foot curve, as above suggested. This would obviate the necessity of other improvements.

The commerce at this locality is confined to that connected with the railroad.

The petition also asked for a breakwater on Green's Ledge, to protect the channels and wharves at Wilson's Point and afford incidental protection to passing vessels, but it seems that this idea has been abandoned for the present. The cost of such a work would be about \$260,000, but there does not appear to be a necessity for it.

D. O. HOUSTON,
Lieut. Col. of Engineers.

D 12.

IMPROVEMENT OF FIVE MILE RIVER HARBOR, CONNECTICUT.

This harbor is an inlet on the north shore of Long Island Sound, about 2 miles west of the mouth of Norwalk Harbor, Connecticut. It is about one mile long and from three hundred to eight hundred feet wide; about three quarters of a mile above its mouth it runs bare at low tide, at the mouth the depth is about 3 feet, increasing to 9 feet at a point about 750 feet out into the Sound.

The mean rise of tide is about 7 feet.

Since 1848 Five Mile River has been largely engaged in oyster growing, and in this business now employs about one hundred and twenty vessels.

These vessels can only enter or leave the harbor at high tide; consequently during their busy seasons they are obliged to lay up for the night at other and less convenient harbors.

PROJECT FOR IMPROVEMENT.

By act of Congress approved August 5, 1886, a survey or examination of this harbor was ordered, which was made in the following fall and reported on under date of December 7, 1886, and printed in the Annual Report of the Chief of Engineers for 1886, Part I, page 639.

In this report a project for improvement was proposed, which consisted in dredging a channel 8 feet deep at mean low water and 100 feet wide, to extend up the harbor and to be about 6,000 feet long; the estimated cost was \$25,000. This project was adopted in 1888, when work under it was ordered by the appropriation of \$5,000 made by act of Congress of August 11, 1888.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1889.

Under the appropriation mentioned above proposals for dredging by the cubic yard were duly advertised for, and at the time of opening, December 13, 1888, but one proposal had been received. The price offered was considered altogether too large and the proposal was rejected. Advertisement was made for hire of dredging plant by the hour, and

proposals were opened March 13, 1889. A contract for this work was entered into under date of April 9, 1889, with Richard Parrott, of Newburgh, N. Y., at the rate of \$8.50 per hour, with a guaranty of at least 50 cubic yards per hour in ordinary depth and material. Work was begun May 22, and up to the close of the fiscal year the dredge had worked 207 hours, removing 10,976 cubic yards and making an 8-foot channel 40 feet wide and 750 feet long. The contract is still in progress.

PRESENT CONDITION OF IMPROVEMENT.

The work now under way is the first that has been done in this harbor, and its condition is as stated above.

PROPOSED OPERATIONS.

Under the present contract the channel will be extended as far up the harbor as practicable.

With future appropriations it is proposed to complete the channel as projected, and for this work \$10,000 could be profitably expended during the ensuing fiscal year.

The only appropriation made for this harbor is the one of \$5,000 by act of Congress of August 11, 1888, which is now being expended.

Five Mile River is in the Fairfield collection district, and is about 13 miles west of Bridgeport, the port of entry. The nearest light-house is on Sheffield's Island, nearly 2 miles from the mouth of the harbor. The nearest work of defense is Fort Schuyler, at the head of Long Island Sound, 27 miles southwest.

Money statement.

Amount appropriated by act of August 11, 1888.....	\$5,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$383.53
July 1, 1889, outstanding liabilities.....	1,859.50
July 1, 1889, amount covered by existing contracts.....	2,756.97
	<hr/> 5,000.00
<hr/>	
{ Amount (estimated) required for completion of existing project.....	20,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in Five Mile River Harbor, Connecticut, opened December 13, 1888, by Col. D. C. Houston Corps of Engineers.

No.	Name and address of bidder.	Rate per cubic yard (20,000 cubic yards).	Amount of bid.
		Cents.	
*1	Hartford Dredging Company, Hartford, Conn.....	23	\$4,600

*Only bid; no contract awarded.

NOTE.—Amount available for contract work, \$4,500.

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Abstract of proposals for hire of dredging plant for improving Five Mile River Harbor, Connecticut, opened March 13, 1889, by Col. D. C. Houston, Corps of Engineers.

No.	Name and address of bidder.	Rate per hour.	Guaranteed rate of excavation per hour.	Remarks.
*1	Richard Parrott, Newburgh, N. Y.....	\$8.50	<i>Cubic yards.</i> 50	17 cents per cubic yard.
2	J. H. Fenner, Jersey City, N. J.....	14.00	60	23½ cents per cubic yard.

*Entered into contract April 9, 1889; in progress.

NOTE.—Amount available for contract, \$4,500.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR, 1888.

Bushels of oysters raised.....	600,000
Value of oysters raised.....	\$360,000
Steamers employed.....	52
Sail-vessels employed.....	100
Value of vessels.....	\$200,000

D 13.

IMPROVEMENT OF STAMFORD HARBOR, CONNECTICUT.

This is a small harbor on the north shore of Long Island Sound, about 6 miles east of the New York State line. The harbor consists of a bay about a mile long and a mile broad and of the mouth of Mill River, a small stream, which is dammed at Oliver Street Bridge at the head of the harbor. The original low-water depth for a mile below the bridge was from 1 to 3 feet in a crooked channel, and the 6-foot curve in the bay was about 6,600 feet below the bridge; the wharves are all in the upper half of this distance.

The mean rise of tides is 7.9 feet.

PROJECTS FOR IMPROVEMENT.

By act of March 2, 1829, Congress appropriated \$100 for "making a survey of the harbor of Stamford, Conn., with a view to its improvement."

The survey was made by Capt. Hartman Bache, U. S. Engineers, in 1829; in his report on the same, dated May 10, 1830, Captain Bache recommends excavating the channel (proposing to build a steam dredge for the purpose), to cost:

For a channel 12 feet deep at ordinary high water (about 4 feet at mean low water).....	\$13,250.00
For a channel 10 feet deep at ordinary high water.....	11,035.20

No money was appropriated for carrying out this plan.

The river and harbor bill of 1882 authorized a survey of this harbor, which was made in the following year. In his report on this survey dated December 12, 1883, printed in Senate Ex. Doc. No. 50, Forty-eighth Congress, first session; also in the Annual Report of the Chief of Engineers for 1884, Part I, page 672, Colonel McFarland, U. S. Engi-

neers, submitted a project for dredging a channel 80 feet wide and 5 feet deep at mean low water from deep water in the bay up to Oliver Street Bridge, estimated to cost as follows:

Dredging 80,000 cubic yards of mud, at 20 cents.....	\$16,000
Contingencies.....	4,000
Total.....	20,000

It was not intended to include the removal of the ledge under and just below the bridge.

The beginning of work under this project was approved by the Secretary of War August 30, 1886, after the first appropriation for improving the harbor had been made.

Up to July 1, 1888, the channel had been dredged 5 feet deep at mean low water, with width of 75 feet for the lower half of its projected length and 50 feet wide above.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1889.

An appropriation of \$5,000 was made by act of Congress of August 11, 1888, for continuing this improvement, and under date of February 4, 1889, a contract was entered into with the Hartford Dredging Company, of Hartford, Conn., for dredging, to widen the channel, at the rate of 18 cents per cubic yard. Work under this contract was begun March 8, and completed April 15, 1889, 22,504 cubic yards of mud, sand, and gravel being removed. The channel was widened to the full width required for a distance of 4,700 feet, about three-quarters its projected length, width 25 to 50 feet; greater width at the sharpest bends.

PRESENT CONDITION OF IMPROVEMENT.

From the bend below Flint Rock up to within 1,200 feet of Oliver Street Bridge, the 5-foot channel is from 80 to 100 feet wide; above that point it is 50 feet wide; the width at the bends is somewhat greater.

For about 500 feet below Flint Rock, at the entrance of the dredged channel, the natural depth is from 1 to 5 inches short of 5 feet, and the bottom very soft. Here the channel has not been dredged yet.

PROPOSED OPERATIONS.

Future appropriations will be applied to completing the project; \$5,000, the remainder of the original estimate, could be profitably expended for this purpose during the next fiscal year.

Appropriations for improving Stamford Harbor have been made as follows, viz:

Date.	Application.	Amount.
Mar. 2, 1839	Survey	\$100
Aug. 2, 1882	....do	250
Aug. 5, 1886	Dredging	10,000
Aug. 11, 1888	....do	5,000
	Total	15,450

Stamford Harbor is in the Fairfield collection district of which Bridgeport is the port of entry. There is a light-house on the Middle Ground at the harbor entrance. The nearest work of defense is Fort Schuyler, Throg's Neck, N. Y., 20 miles to the southwest.

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Money statement.

July 1, 1888, amount available	\$24. 08
Amount appropriated by act of August 11, 1888	5, 000. 00
	<hr/> 5, 224. 08
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	4, 593. 74
	<hr/> 630. 34
July 1, 1889, balance available	
<hr/>	
{ Amount (estimated) required for completion of existing project	5, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	5, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in Stamford Harbor, Connecticut, opened December 13, 1888, by Col. D. C. Houston, Corps of Engineers.

No.	Name and address of bidder.	Rate per cubic yard (20,000 cubic yards).	Amount of bid.
		Cents.	
*1	Hartford Dredging Company, Hartford, Conn	18	\$2, 000
2	Henry E. DuBois, New York City	23½	5, 000
3	A. J. Beardale & Son, Bridgeport, Conn.	24	4, 800
4	John H. Fenner, Jersey City, N. J.	24½	4, 900

NOTE.—Amount available for contract work, \$4,500.

*Lowest bid; contract entered into with the Hartford Dredging Company, under date of February 4, 1889; contract completed April 15, 1889.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1888.

	No.	Tonnage of cargoes.	Value of cargoes.
Vessels arrived	168	29, 561	\$216, 745
Vessels departed	40	2, 300	50, 000

RECEIPTS.

	No. cargoes.	Tons.	Value.
Coal	85	19, 313	\$98, 942
Lumber	5	1, 809	10, 000
Miscellaneous	100	6, 979	62, 000

Maximum draught of vessels 12 feet.

The above is commerce by water, and does not include what comes into town via "the canal"—a private channel.

D 14.

IMPROVEMENT OF PORT CHESTER HARBOR, NEW YORK.

This harbor consists of the lower part of the Byram River, and a bay at its mouth opening into Long Island Sound. This river for about 1½ miles from its mouth forms the dividing line between the States of New York and Connecticut. It was formerly navigable to a point within a few hundred feet of the bridge at Port Chester, a little more than 1 mile from the mouth.

Before improvement the depth below the wharves was in some places as little as 1 foot at mean low water. The mean rise of tide is 7.4.

PROJECTS FOR IMPROVEMENT.

A survey of this harbor was made in 1871, and a project based on this was submitted and adopted. It provided for the removal of two rocks; Sunken Rock at the entrance to the bay with 5.7 feet low-water depth, to be removed to 11 feet depth, and Salt Rock about 1,000 feet above the mouth of the river, partly bare at low water, to be removed to 9 feet depth, also a breakwater 400 feet long at Byram Point. The estimated cost of the whole was as follows, viz:

Sunken Rock, 1,474.5 cubic yards, at \$40.....	\$58,980
Salt Rock, 316.3 cubic yards, at \$40	12,652
Breakwater at Byram Point	25,000
Total.....	96,632

Under this project Salt Rock was removed in 1873. No farther work was done until 1884, when a survey of the channel was made under the appropriation of August 2, 1882, and a project for extending the funds available in 1884 (about \$16,000), based on this survey, was submitted and approved. It provided for making a channel from 60 to 100 feet wide and 2½ feet deep at mean low water from the bay to the vicinity of the bridge at Port Chester. This modification was made in deference to the wishes of the business men of Port Chester. The channel was completed to within 150 feet of the bridge in May 1885. A contract was entered into May 15, 1886, with W. K. Pidgeon for the hire of the necessary plant for straightening and leveling the channel, and removing lumps left by the previous contractor both in the river and bay. This contract was completed July 22, 1886, 9,232 cubic yards of sand and gravel having been removed.

In the project for expenditure of \$5,000 appropriated in 1888 a change was made in the project, omitting the removal of Sunken Rock and changing the location of the proposed breakwater so as to make it extend from Sunken Rock towards the shore. Sunken Rock had been dangerous only because it was submerged and at the edge of the channel; the width of the channel at that point was sufficient for all prospective needs. A breakwater on the rock, rising above high water, would serve as a beacon and be an aid instead of a danger to navigation, besides affording more effective shelter than the originally proposed breakwater; thus it would take the place both of the breakwater and of the removal of Sunken Rock, together estimated to cost \$83,980.

The total cost of the breakwater extended from Sunken Rock to Byram Point is estimated at \$15,000.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1889.

Under the appropriation of \$5,000 made by act of Congress August 11, 1888, a contract for construction of a breakwater to extend shoreward from Sunken Rock was entered into with S. & E. S. Belden, of Rocky Hill, Conn., under date of January 2, 1889. Rate per ton of rip-rap delivered in the work, \$1.19.

Work was begun March 18, and completed May 22, 3,698 tons of stone being placed in the breakwater, building it from Sunken Rock shoreward for a length of 288 feet.

PRESENT CONDITION OF IMPROVEMENT.

Salt Rock has been effectually removed.

An available channel, 2½ feet deep at mean low water and from 60 to 100 feet wide to a point 150 feet below the bridge and 25 feet wide to the bridge, has been dredged, and in front of the wharves, where vessels lie aground at low tide. The bottom has been leveled as nearly as practicable.

Two hundred and eighty-eight linear feet of the breakwater have been built, with top width of 5 feet, rising to 1 foot above high water and with slopes of 1 upon 1; the end of the breakwater resting upon Sunken Rock was built to 5 feet above high water, to serve as a beacon.

PROPOSED OPERATIONS.

With future appropriations it is proposed to extend the breakwater to high-water mark on Byram Point, a distance of about 343 feet. The estimated cost of this work is \$10,000, which sum could be advantageously applied to that purpose during the ensuing fiscal year.

Appropriations for improving Port Chester Harbor have been made as follows, viz:

Date.	Application.	Amount.
June 10, 1872.	Removing Salt Rock.....	\$12,000
Aug. 2, 1882.	Dredging in Byram River and Bay.....	15,000
Aug. 11, 1888.	Breakwater.....	5,000
	Total.....	32,000

Port Chester Harbor is in the collection district of New York. The nearest light-house is on Great Captain's Island, 1½ miles east of the mouth of the harbor. The nearest work of defense is at Throg's Neck, about 15 miles southwest.

Money statement.

July 1, 1888, amount available.....	\$24.77
Amount appropriated by act of August 11, 1888	5,000.00
	5,024.77
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	5,010.06
July 1, 1889, balance available	14.71
{ Amount (estimated) required for completion of existing project.....	64,632.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	20,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

1889.

Port Chester Harbor
New York

Condition of Improvement
June 30. 1889

Scale.



Abstract of proposals for construction of breakwater at Port Chester, N. Y., opened December 13, 1888, by Col. D. C. Houston, Corps of Engineers.

No.	Name and address of bidder.	Rate per ton (3,400 tons.)	Amount of bid.
1	John R. Howell, New York City	\$1.65	\$5,610
2	Francis H. Smith, New York City	1.45	4,930
3	John A. Bouker, New York City	1.23	4,182
4	John Beattie, Lees Island, Conn	1.40	4,760
*5	S. & E. S. Belden, Rocky Hill, Conn	1.19	4,046

*Lowest bid; entered into contract January 19, 1889; contract completed May 23, 1889.

NOTE.—Amount available for contract work, \$4,500.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1888.

Arrivals and departures.	Number.	Tonnage.
Steamers	500	58,000
Sailing vessels	350	19,000
Barges, etc	650	100,000
Total	1,500	229,000

Draught of above vessels, 5 to 8½ feet; tonnage, from 25 to 300 tons.

Cargoes.

	Tons.	Value.
Shipments	17,000	\$690,000
Receipts	85,000	850,000
Total	102,000	1,540,000

The principal articles of commerce are manufactured goods, coal, iron, building materials, and general merchandise.

D 15.

IMPROVEMENT OF ECHO HARBOR, NEW ROCHELLE, NEW YORK.

Echo Harbor is a bay on the north shore of Long Island Sound, distant about 22 miles by water from the Battery at New York. It is land-locked, except toward the southeast, and has a good anchorage. Nearly all of the water transportation of the town of New Rochelle is carried on through this harbor.

The depth in the bay varies from 6 to 15 feet at mean low water, though the low-water channel up to the wharves is only from 1 to 2 feet deep.

The mean rise of tide is 7.3 feet.

PROJECT FOR IMPROVEMENT.

A survey was made in 1875, and a project based on it was submitted December 20, 1875, and subsequently adopted, providing for the removal of two rocky reefs from the channel, viz:

(1) Sheepshead Reef, lying midway between Echo Island and Duck Point, which had 1.6 feet of water upon it at low tide. This was to be re-

moved to a depth of 9 feet at low water, which required the excavation of 872.5 cubic yards of rock, costing \$21,201.75.

(2) Start Rock, which projected about 2 feet above low water, and lay in the channel 120 feet from Beaufort Point. This was to be removed to 7 feet below low water, requiring the excavation of—

370 cubic yards of rock, costing.....	\$12, 672. 50
Contingencies.....	5, 081. 13
Total.....	38, 955. 38

A depth of 7 feet over Start Rock was obtained in January, 1880, and in 1881-'83 506 cubic yards were removed from the southern part of Sheepshead Reef, making 9 feet depth. In May, 1889, a petition of residents of New Rochelle was submitted, asking that the money then available be expended in dredging up to the wharves. This was approved by the Chief of Engineers.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1889.

The money available was not sufficient to continue the original project, and nothing was done further than to make preparations for expenditure of the available money, as approved.

PROPOSED OPERATIONS.

With the balance remaining from previous appropriations a channel of as great width and depth as possible will be dredged up to the wharves. With future appropriations the removal of Sheepshead Rock will be completed.

The balance of the original estimate not yet appropriated, \$17,000, will be sufficient for this work, and it could be advantageously expended in a single year.

Appropriations for improving Echo Harbor, New Rochelle, N. Y., have been made as follows, viz :

Date.	Application.	Amount.
June 18, 1878	Removal of Start Rock	\$10, 000
Mar. 3, 1879	do	2, 000
June 14, 1880	Removal of Sheepshead Rock.....	2, 000
Mar. 3, 1881	do	2, 000
Aug. 2, 1882	do	2, 000
	Total	22, 000

Echo Harbor is in the collection district of New York. The nearest light-house is on Execution Rock. The fortifications at Throg's Neck, 7 miles to the westward, are the nearest works of defense.

Money statement.

July 1, 1888, amount available.....	\$3, 043. 97
July 1, 1889, balance available.....	3, 043. 97

{ Amount (estimated) required for completion of existing project.....	17, 000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	17, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1888.

Arrivals and departures of vessels.

	Number.	Tonnage.
Steamers.....	320	25,000
Sailing vessels.....	225	20,000
Barges, etc.....	210	42,000
Total.....	755	87,000

CARGOES.

	Tons.	Value.
Shipments.....		
Receipts.....	57,000	\$1,114,000
Total.....	57,000	1,114,000

The principal articles of commerce are coal, building materials, and general merchandise.

The New Rochelle Yacht Club, which is largely interested in the removal of rocks from this harbor, includes 40 vessels of sizes ranging from 60 tons downward.

D 16.

IMPROVEMENT OF NEW ROCHELLE HARBOR, NEW YORK.

New Rochelle Harbor is situated at the west end of Long Island Sound, on its north shore, about 10 miles west of the boundary between the States of New York and Connecticut; it lies off the southerly part of the town of New Rochelle, while Echo Harbor is off the northerly part. The harbor itself consists of rather narrow and circuitous passages between several rocky islands and reefs, which shelter it from rough weather. The original depth of the main channel in this harbor was from 8 to 9 feet at mean low water; there were two rocks in or near the channel-way whose removal was desired, and the narrowness of the deep-water channel at the head of the harbor made it necessary for steamers to back out.

Glen Island, a popular summer-day resort for excursion and picnic parties from New York City, lies in the middle of this harbor; between the harbor and Long Island Sound lies Davids Island, one of the principal recruiting posts for the Army.

The improvement of this harbor was desired chiefly in the interest of Glen Island as a summer resort; no harbor improvement seems to have been needed for Davids Island, and the commerce by water for the town of New Rochelle is carried on almost wholly in Echo Bay.

PROJECTS FOR IMPROVEMENT.

A survey of New Rochelle Harbor was ordered by the act approved June 14, 1880, and made in the same year. In the report of this survey January 28, 1881, a project for improvement was submitted contemplating the removal of Corning Rock to 12 feet depth at mean low

water, of Rock C to 9 feet depth, the dredging of a channel 100 feet wide and 8 feet deep around the south end of Glen Island to connect with the channel around the north end of that island, and the removal of a reef that obstructed the entrance to this projected channel, the whole being estimated to cost \$40,825. The object of this dredging and rock removal was to allow vessels to pass around the island instead of having to turn in the narrow channel.

In 1881 the channel around Glen Island was dredged 100 feet wide and 6 feet deep, and work was begun under a contract to remove the reef at the channel entrance to 8 feet depth.

The contract was extended, and in 1883 work was abandoned by the contractor while parts of the rock were still from 1 to 1½ feet above the plane of removal.

In 1883 Corning Rock was removed to 11 feet depth by hired labor, at a cost of about \$34 per cubic yard.

A large boulder was removed from near Davids Island wharf, and 10.6 cubic yards of loose rock were removed from the reef at the entrance to the dredged channel, making a depth of 7.5 feet there.

An examination of the dredged channel and the rocks at the entrance was made in April, 1887. By this examination a reef was discovered, not shown on the original survey, projecting about 40 feet into the proposed channel, with a least depth of 6 feet; also a rock known as Rock B, projecting about 10 feet into the proposed channel, with a least depth of 2.9 feet. Authority was obtained under date of April 30, 1887, to complete the removal of the reefs at the entrance by hired labor, and to deepen the dredged channel to 8 feet at mean low water by contract.

The removal of rock was completed in 1888, making 8 feet depth at mean low water upon Rock B, and a depth of 7½ feet or over upon the above mentioned reef.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1889.

The act of Congress of August 11, 1888, as far as relates to this harbor, directed "the balance remaining on hand from former appropriations to be expended in pursuance of the project adopted in 1871." As the only project for this improvement was that of 1881, it was presumed that this was intended, and proposals for dredging to make the channel around Glen Island 8 feet deep were advertised for, to be received May 29, 1889. The parties interested in the proposed work were notified of the advertisement, but no bids for the work were received, and as its completion is not of urgent importance it was not deemed best to re-advertise at once.

Shortly after advertising for proposals, as above, I was informed that the wording of the proviso in the act of Congress of August 11 was intended to make the balances appropriated for New Rochelle Harbor applicable to completing the improvement of Echo Harbor, and that it was so understood by Congress. The date of the project for Echo Harbor is 1875, and there is nothing in the law itself to warrant such an interpretation of it.

PRESENT CONDITION OF IMPROVEMENT.

A channel 100 feet wide and with a minimum depth of 7.5 feet at mean low water has been made through the rocks at the entrance. The dredged channel has nearly retained its depth of 6 feet at mean low water. No work has yet been done on Rock C.

PROPOSED OPERATIONS.

It is proposed to expend the available funds in carrying out the project of 1881, but as the need for this work is not urgent it will be deferred until 1890.

Appropriations for the improvement of New Rochelle Harbor have been made as follows:

Date.	Application.	Amount.
Mar. 2, 1881	Dredging and partial removal of rock at mouth of Glen Island Channel.....	\$30,000
Aug. 2, 1882	Removing Corning Rock.....	15,000
	Total	35,000

New Rochelle Harbor is in the collection district of New York. The nearest light-house is on Execution Rock. The fortifications at Throg's Neck, 7 miles west, are the nearest works of defense.

Money statement.

July 1, 1888, amount available	\$9,134.97
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	108.27
July 1, 1889, balance available.....	9,026.70

COMMERCIAL STATISTICS.

The following statement, from the annual report of 1888, fairly represents the business of the present year, which consists almost entirely of transportation of passengers to and from the picnic grounds at Glen Island, and of provisions for their accommodation and enjoyment.

Kind.	Number.	Tonnage.
Steamers	3,358	1,265,400
Sailing vessels.....	8	1,250
Barges, etc	580	442,900
Total	3,946	1,710,550

The draught of vessels trading at New Rochelle Harbor ranges from 5 to 9 feet. Their tonnage ranges from 25 to 950 tons.

Cargoes.—Receipts: Tons, 10,850; value, \$98,040. The principal articles of commerce are building materials and general merchandise. Over 700,000 passengers were brought into the harbor during the year.

D 17.

IMPROVEMENT OF EAST CHESTER CREEK, NEW YORK.

East Chester Creek is a small stream which, for the last 4 miles of its course, traverses marshes of one-quarter to 1 mile width and empties into East Chester, or Pelham Bay, a large bay on the north shore of Long Island Sound, just east of Throg's Neck, and 20 miles by water from the Battery at New York. The width of the creek varies from 25 feet to half a mile at high water, but the channel was narrow everywhere.

Pelham Bridge, a highway bridge, crosses the creek near its mouth. A short distance above is the bridge and trestle of the Harlem River Branch of the New York, New Haven and Hartford Railroad, and about $2\frac{1}{2}$ miles above its mouth, at Lockwood's, the stream is crossed by the Boston road.

The mean rise of tide at the mouth of the creek is 7.1 feet.

For half a mile up the creek there was originally a channel with from 3 to 9 feet depth at low tide, but the depth decreased farther up, and to Town Dock, the principal landing, about $1\frac{1}{2}$ miles from the mouth, the available depth at high water was only about equal to the rise of tide. Above Town Dock the stream was very crooked and narrow, and the available depth about the same.

The commerce at Town Dock was principally bringing coal and building materials for the villages of East Chester and Mount Vernon; the latter is a rapidly growing place, with a present population (1889) of about 11,000 (?). The main part of the settlement is about 2 miles from Town Dock. It is understood to be mainly for the benefit of prospective Mount Vernon commerce that the improvement of East Chester Creek is desired.

PROJECTS FOR IMPROVEMENT.

In 1871 a survey of East Chester Creek was ordered by Congress and was made, and as the report on the same, dated January 19, 1872, and printed in the Annual Report of the Chief of Engineers for 1872, page 812, three plans of improvement were outlined, viz:

For making and maintaining, by means of a tidal basin and system of dikes, a channel 9 feet deep at mean low water, estimated to cost \$1,646,000.

For making and maintaining, in the same way, a channel of 11 feet deep at mean high water (about 4 feet deep at low water), estimated to cost \$731,000.

For securing 7 feet depth of slackwater navigation by means of a lock above Goose Island (about half a mile from the mouth of the creek), estimated to cost \$300,000.

No recommendation as to worthiness of improvement accompanied these estimates. March 25, 1872, the House of Representatives passed a resolution inquiring the cost of removing obstructions between tide-gauges No. 1 and No. 2, so as "to afford the same depth of water above station No. 1 as now prevails below it." In reply to this resolution a report was submitted April 3, 1872 (see Annual Report of the Chief of Engineers for 1872, page 814), containing the following estimates:

Basin, purchase of site, 18 acres, at \$150.....	\$2,700
Excavation to level of mean low water, 200,000 cubic yards, at 40 cents....	80,000
Excavation of cut, 60,000 cubic yards, at 40 cents.....	24,000
Diking and resetting banks of cut.....	12,000
Engineering and contingencies.....	17,805
Total	136,505

This plan contemplated (as appears from maps on file) straightening the channel at Lockwood's, and as it was necessary in any case to replace the old arch bridge of the Boston road by a draw-bridge it was proposed to change the location of such bridge to a point about 700 feet eastward, as giving a better and cheaper channel for the stream.

In 1873 \$25,000 was appropriated for improvement of this stream; it was intended to expend it under the above estimates, which were then considered an adopted project, but as no authority was given to

purchase the land required for the cut at Lockwood's no work was done at that time. In 1875 \$12,000 more was appropriated, but it was not until 1877 that a commission appointed by the State of New York had succeeded in obtaining the land for the proposed cut.

In 1875 it became apparent that the location of the bridge at Lockwood's could not be changed. The bridge was supported jointly by the towns of Pelham and East Chester, and the change proposed would make it lie wholly within the town of Pelham, which town would then have to support it, and therefore would not consent to the change, so it became necessary to lay out the cut to meet the bridge at its old location, which was done at an estimated increased cost of \$10,000 (see General Newton's letter to the Chief of Engineers, September 24, 1875). At about this time the old bridge was replaced by an iron draw-bridge.

In 1877, after the commission had secured the right of way, a contract was entered into for making a cut 9 feet deep at mean high water (2 feet at low water) with a width of 100 feet at high-water level; this contract included about 3,149 cubic yards of rock removal, 1,210 linear feet of pile dike, and 140 linear feet of crib dike. It was completed in 1878, and in that year and 1879, under an appropriation of \$10,000, made June 18, 1878, dredging was done by hired labor, removing a shoal of bowlders just outside of Pelham Bridge, and making a channel about 125 feet wide and 9 feet deep at high water on the west side of Goose Island, being practically an extension of the original project.

In 1879 \$3,500 was appropriated for continuing this improvement, and \$3,500 more in 1880; these appropriations were not expended until 1883. In the Annual Report for 1879 it was stated as necessary to complete the improvement from Pelham Bridge to Lockwood's "to construct dikes from the lower end of the cut to Goose Island, a distance of 5,500 feet." Under an apparent revision in 1880, this was spoken of as a dike 5,600 feet long, which "could be constructed at a cost of about \$40,000."

The extension of the cut above Lockwood's and the above system of dikes were apparently abandoned for the time being, appropriations not being made in sufficient amount to warrant undertaking those works, and in 1881 General Newton, U. S. Engineers, then in charge, reported that "furthermore, until it is proved that a depth of 9 or 10 feet * * * can not be maintained under the scale of improvement already completed, it will be unnecessary to inaugurate new works. The amount of funds available, \$7,372.14, will be quite sufficient for the present wants of the case."

This money was expended in 1884 in dredging just below Town Dock, a work not included in the original estimate.

August 5, 1886, \$10,000 were appropriated for this improvement, which has been mostly expended in dredging between Town Dock and Lockwood's, to remove shoals, some of which had formed in the cut made in 1877.

It thus appears that, outside of the original estimate, \$84,600 have been either expended or estimated for for works not included in the original estimate, and that estimate should be increased to \$221,000, if it is proposed to carry it out completely with these extensions.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1889.

At the beginning of this year a contract was in progress with the Hartford Dredging Company for dredging between Town Dock and Lockwood's, to remove shoals of less than the required depth of 9 feet

at mean high water. Much difficulty was experienced in finding a dumping-ground which would meet with approval of the several State authorities which claimed jurisdiction, and on this account work was suspended July 12. In October, with the consent of the supervisor of the port of New York, an arrangement was made for placing dredged material behind bulkheads at City Island, and work was resumed November 6, and suspended for the winter December 15. In the meantime an extension of contract to June 30, 1889, had been granted.

Dredging was begun again March 21, and completed April 25, 1889, 9,295 cubic yards having been dredged during the fiscal year, making a total of 11,067 cubic yards under the contract. The available money had not been all expended, but the required depth had been made up to Lockwood's, with width sufficient to meet the wants of local traffic. Greater width will not be required until there is prospect of the extension of the work above Lockwood's.

It was proposed to expend the appropriation of \$5,000, made August 11, 1888, in dredging a cut above Lockwood's, and in January, 1889, the line of cut was staked out and a description given to the State commissioners for securing right of way.

They were requested to obtain permission to deposit the material on the marsh land adjacent to the cut, which could be done cheaply as compared with the cost of carrying it out to Long Island Sound. The commissioners reported that this consent could not be obtained, and as the funds available would not be sufficient to begin work under any other plan of disposing of dredged material, work was postponed until larger appropriations should be made.

PRESENT CONDITION OF IMPROVEMENT.

There is a channel not less than 9 feet deep at mean high water (2 feet at low water) from the bay up to Lockwood's, being 100 feet wide or more to a point 1,000 feet above Town Dock; thence for a distance of 1,275 feet, 75 feet wide; and thence to Lockwood's, about 500 feet, 50 feet wide. The dikes on the east side of the channel below Lockwood's are in fair condition.

The cut above Lockwood's has not been begun.

PROPOSED OPERATIONS.

The dikes below Town Dock do not seem to be necessary now as a means of improving or maintaining the channel, and possibly they may be ultimately dispensed with.

The completion of the project requires the excavation of a channel 100 feet wide and 9 feet deep at mean high water, up to tide gauge No. 1, a distance of about 3,000 feet through marsh land, and not closely following the windings of the stream. The cost of towing dredged material from this locality to the authorized dumping-ground is so great that very little can be accomplished with the funds available unless arrangements can be made to deposit the material to be excavated upon the banks. It has been impossible so far to obtain the consent of property owners for this purpose. Unless this is done, and larger appropriations are made for the improvement than heretofore, it will be useless to continue it. At least \$25,000 should be available to commence this part of the work advantageously and economically.

Unless it is considered advisable to extend the improvement above Lockwood's no additional funds are needed. There is at present no navigation above this point, and it is problematical whether there will be to any great extent should the proposed improvement be made.

Appropriations for improving East Chester Creek have been made as follows, viz :

Date.	Application.	Amount.
Mar. 3, 1873	Cutting through marsh and rock, and diking (in 1877)	\$25,000
Mar. 3, 1875	Dredging under Boston Road Bridge, and at Goose Island.	12,000
June 18, 1878	Dredging near Lockwood's, Goose Island, and Pelham Bridge	10,000
Mar. 3, 1879	{ Dredging 40 to 90 feet wide from Pell Point to Town Dock	2,500
June 14, 1880		2,500
Aug. 5, 1886	Dredging above Town Dock (not wholly expended)	10,000
Aug. 11, 1888	Not yet expended	5,000
Total		69,000

East Chester Creek is in the collection district of New York. The nearest light-house is on the Stepping Stones, 3 miles southeast of the mouth of the creek. The nearest work of defense is Fort Schuyler, Throg's Neck, about $3\frac{1}{2}$ miles south.

Money statement.

July 1, 1888, amount available	\$767.60
July 1, 1888, amount covered by contract which was not completed	7,650.00
Amount appropriated by act of August 11, 1888	5,000.00
	13,417.60
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	6,254.52
July 1, 1889, balance available	7,163.08
{ Amount (estimated) required for completion of existing project	152,100.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

No statistics are yet received for the past year; the following, referring to the calendar year of 1886, gives a fair idea of the general annual commerce on this stream.

Kind.	Number.	Tonnage.
Sailing-vessels	8	200
Barges, etc	90	15,750
Total	98	16,110

The draught of vessels trading in East Chester Creek ranges from 5 to $7\frac{1}{2}$ feet. Their tonnage ranges from 30 to 200 tons.

Cargoes: Receipts, 10,625 tons; value, \$61,075.

The principal articles of commerce are coal and building materials.

D 18.

IMPROVEMENT OF GREENPORT HARBOR, NEW YORK.

This harbor is a roadstead near the east end of the north fork of Long Island, lying between this north fork on the northwest and north and Shelter Island on the southeast and south. The anchorage ground is exposed to storms from the northeast and east.

A sand spit, called Joshua's Point, formerly protected the Little Bay at Greenport from easterly storms, but in the few years prior to 1883

this had worn away rapidly, and the sand had been carried into the bay.

The mean rise of the tide is 2.4 feet.

PROJECT FOR IMPROVEMENT.

In 1881 a survey was made, and, with the report, a plan and estimates based upon the survey were submitted and subsequently adopted for a breakwater extending southeasterly from Joshua's Point. This project consisted of a riprap breakwater about 1,700 feet long, extending from high-water mark to the 18-foot curve, to be built 3 feet above mean high-water level, with a top width of 5 feet and side slopes of 1 on 1, to contain about 23,000 tons of stone. Its estimated cost was \$46,000.

Work under this project was begun in 1883, and up to July 1, 1888, 14,775 tons of riprap had been placed in the breakwater, making its total length 1,437 feet.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1889.

An appropriation of \$5,000 was made for continuing this improvement, and, after duly advertising for and opening proposals, a contract, dated January 19, 1889, was entered into with William H. Molthrop & Co., of Gale's Ferry, Conn., for delivering in the breakwater about 3,400 tons of riprap granite at the rate of \$1.23 per gross ton. Work on this contract was begun March 29, 1889, and up to the close of the fiscal year 2,410 tons of riprap had been delivered and accepted, building 98 linear feet of the work. The contract is in progress, expiring August 1, 1889.

PRESENT CONDITION OF IMPROVEMENT.

The breakwater is in fair condition as far as completed. No material changes of depth in the harbor have occurred since the original survey.

PROPOSED OPERATIONS.

With future appropriations the breakwater will be completed as projected to the 18-foot curve. Thirty thousand dollars have been appropriated for this work; the remainder of the estimate, \$16,000, could be profitably expended in one year in completing the breakwater.

Appropriations for improving Greenport Harbor have been made as follows:

Date.	Application.	Amount.
Mar. 3, 1881	Survey	\$200
Aug. 2, 1883	Expended on breakwater	10,000
July 5, 1884	.....do	10,000
Aug. 5, 1886	.....do	5,000
Aug. 11, 1888	.....do	5,000
	Total	20,200

Greenport is a port of delivery in the collection district of Sag Harbor. The nearest light-house is on Long Beach Point, 3 miles to the eastward. The nearest work of defense is Fort Trumbull, New London Harbor, Connecticut, 21 miles distant in a straight line.

Money statement.

July 1, 1888, amount available.....	\$40. 10
Amount appropriated by act of August 11, 1888	5,000. 00
	<hr/> 5,040. 10
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$2,553. 06
July 1, 1889, outstanding liabilities.....	1,138. 11
July 1, 1889, amount covered by existing contracts.....	1,217. 70
	<hr/> 4,908. 87
July 1, 1889, balance available	<hr/> 131. 23
<hr/>	
{ Amount (estimated) required for completion of existing project	16,000. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	16,000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for extension of breakwater at Greenport, N. Y., opened December 13, 1888, by Col. D. C. Houston, Corps of Engineers.

No.	Name and address of bidder.	Rate per ton. (3,400 tons.)	Amount of bid.
1	James N. Luce, Niantic, Conn	\$1.32	\$4,438
*2	Wm. H. Moltrop & Co., Gales Ferry, Conn	1.23	4,182
3	Francis H. Smith, New York City	1.45	4,980
4	John A. Bouker, New York City	1.47	4,998
5	John Beattie, Leetes Island, Conn.....	1.35	4,500

NOTE.—Amount available for contract work, \$4,500.

* Lowest bid; contract entered into with Wm. Moltrop & Co., under date of January 19, 1889; in progress.

COMMERCIAL STATISTICS.

No statistics are yet received for the past year; the following, referring to the calendar year of 1886, give a fair idea of the general annual commerce in this harbor.

Arrivals and departures of vessels.

	Number.	Tonnage.
Steamers	2,240	421,000
Sailing vessels.....	1,688	195,750
Barges, etc	16	7,200
Total.....	<hr/> 3,936	<hr/> 623,950

Cargoes.

	Tons.	Value.
Shipments.....	19,500	\$300,500
Receipts.....	83,070	1,128,000
Total.....	<hr/> 43,570	<hr/> 1,428,000

The principal articles of commerce are coal, building materials, farm produce, and general merchandise.

D 19.

IMPROVEMENT OF GLEN COVE HARBOR, NEW YORK.

Glen Cove Harbor is an estuary (or creek) opening into the east side of Hempstead Bay about $1\frac{1}{2}$ miles south from Long Island Sound, and about 25 miles by water from the Battery, New York City. The channel of the creek is about 2 feet deep at mean low water, and on a bar at the entrance to the creek the low-water depth is about 1 foot, so that vessels entering Glen Cove Harbor are compelled to wait for high tide, anchoring in Hempstead Bay, where they are exposed to storms from the north and northwest. During heavy storms from these quarters it is impossible to tow over the bar, and from this cause vessels have been obliged to remain in the bay exposed to the storms for three or four days.

The mean rise of tides is 7.7 feet.

PROJECT FOR IMPROVEMENT.

The act of Congress approved August 5, 1886, provided for a survey or examination of Glen Cove Harbor. A preliminary examination was all that was deemed necessary, and upon this, with assistance of recent United States Coast Survey chart, a report with estimates for improvement was presented, dated December 7, 1886, and printed in the Annual Report of the Chief of Engineers for 1887, Part I, page 645.

The project described in this report contemplated a breakwater about 2,500 feet long and extending in a general westerly direction from Mosquito Point on the east side of Hempstead Bay north of the entrance to Glen Cove Inlet; the breakwater to be constructed of riprap, the top to be 5 feet wide and 3 feet above high water, with side slopes of 1 upon 1, at an estimated cost as follows:

136,000 tons of riprap stone at \$1.35 per ton.....	\$183, 600
Contingencies, 10 per cent.....	18, 360
Total.....	201, 960

This project was adopted in 1888, upon an appropriation made by Congress for beginning the work, and the location of the shore end of the breakwater was definitely fixed to be at the northwest corner of Glen Cove Dock, and its course to be west-southwesterly towards Mott's Point.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1889.

The first appropriation for this improvement was one of \$20,000, made by act of Congress of August 11, 1888. Under this appropriation, after approval of the project, proposals were duly advertised for and opened March 19, 1889, and under date of March 30, 1889, a contract was entered into with Brown & Fleming, of New York City, for delivering about 12,500 tons of riprap and for constructing the commencement of the breakwater.

Work was begun May 20, and up to July 1, 1889, 4,216 tons of stone had been delivered and placed, building 220 linear feet of the work. Under the present contract it is not proposed to build the breakwater quite to the full height and width to which it is ultimately to be brought. Work is still in progress, the contract expiring December 1, 1889.

1889.

Glen Cove Harbor, N.Y.

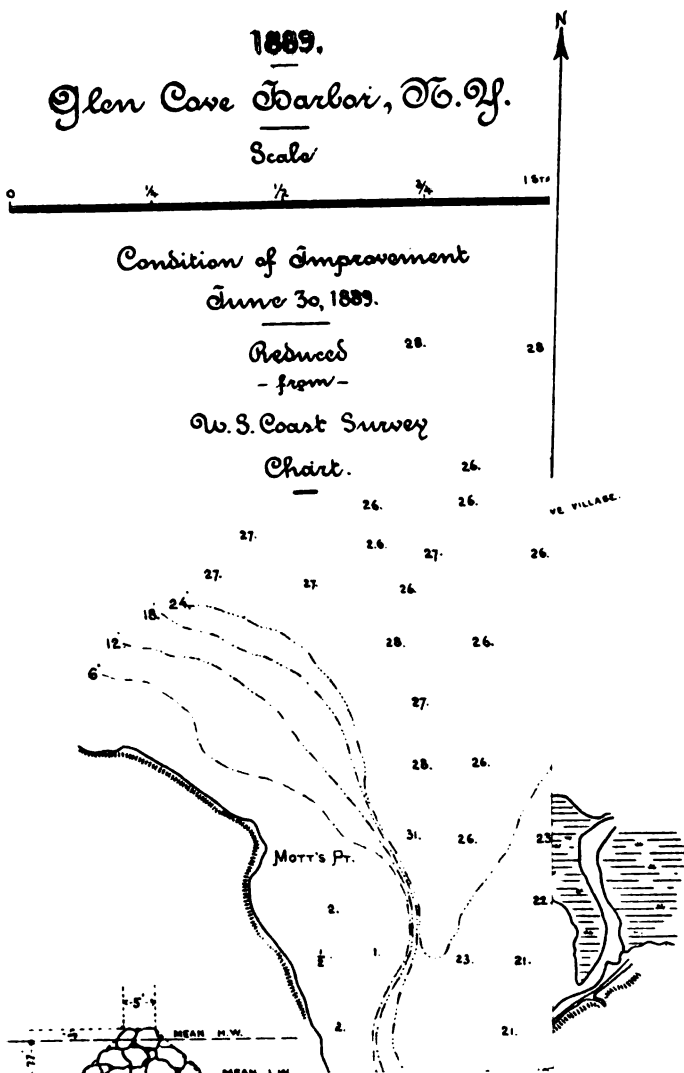
Scale



Condition of Improvement
June 30, 1889.

Reduced
- from -

U. S. Coast Survey
Chart.



As the work lies near the course of vessels coming to Glen Cove Dock, a movable red lantern has been placed at the end and kept lighted from sunset to sunrise.

PROPOSED OPERATIONS.

Under the present contract it is expected that from 500 to 600 linear feet of the breakwater will be built; with future appropriations it is proposed to extend it, as provided for in the project.

The only appropriation for improving Glen Cove Harbor is the one of \$2,000 made August 11, 1888.

Glen Cove Harbor is in the collection district of New York.

The nearest light-house is on Sand's Point, about 4 miles west. Fort Schuyler, New York Harbor, is the nearest work of defense.

Money statement.

Amount appropriated by act of August 11, 1888.....	\$20,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$1,380.86
July 1, 1889, outstanding liabilities.....	2,836.94
July 1, 1889, amount covered by existing contracts.....	7,664.06
	<hr/> 11,661.86
July 1, 1889, balance available.....	<hr/> 8,118.14

{ Amount (estimated) required for completion of existing project.....	181,960.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	50,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for construction of breakwater at Glen Cove Harbor, New York, dated February 13, 1889 and opened March 13, 1889, by Col. D. C. Houston, Corps of Engineers.

No.	Name and address of bidder.	Rate per ton. (12,500 tons.)	Amount of bid.	Remarks.
1	James Scully, Groton, Conn.....	\$1.39	\$17,375	Granite.
2	John S. Howell, New York City.....	1.13	14,125	Stone quarried in New City.
3	Ciancimino's Towing and Transportation Company, New York City.	1.23	15,375	No guarantors. New York quarry stone.
4	Francis H. Smith, New York City.....	1.49	18,625	Granite.
5	John A. Bouker, New York City.....	1.23	15,375	Connecticut River brown-stone and New York stone.
*6	Charles A. Brown, of Elizabeth, N. J., and John Fleming, of New York City.	.83	10,375	Glacial stone, from New York.
7	S. & R. S. Belden, Rock Hill, Conn.	1.28	16,000	Connecticut River sand-stone.

NOTE.—Amount available for contract, \$18,000.

* Lowest bid; entered into contract with Brown & Fleming under date of March 30, 1889; contract in progress.

COMMERCE OF GLEN COVE HARBOR FOR THE YEAR 1888.

Conveyance.	Arrivals and departures.	Registered tonnage.	Imports.		Exports; total value.	
			Quantity.	Value.	Quantity.	Value.
			Tons.		Tons.	
Sailing-vessels.....	1,238	85,910	71,390	\$1,641,970	57,000	\$2,906,320
Canal-boats, barges, etc.	203	29,029	48,600	287,300	21,000	224,000
Steam-vessels.....	720	246,750	36,375	254,635	53,500	422,000
Total	2,171	361,689	156,365	2,163,895	131,500	3,600,320

NOTE 1.—The imports were mainly corn, coal, mill-feed, fertilizers, lumber, timber, brick, cement, lime, flour, dry goods, and groceries.

The exports were mainly manufactured products, corn-feed, fire-clay, fire-sand, potter's clay, hay, potatoes, vegetables, and other farm and garden products.

NOTE 2.—In the columns of "Arrivals and departures" and "Registered tonnage," no account is taken of steam-tugs entering or leaving the harbor, or of steam-yachts, sailing-yachts, or fishing-vessels.

D 20.

IMPROVEMENT OF FLUSHING BAY, NEW YORK.

Flushing Bay is on the north shore of Long Island, about 14 miles, by water, from the Battery at New York. The town of Flushing is on the east bank of Flushing Creek, a quarter of a mile from the head of the bay. The bay is about 1 mile wide and 2 miles long; the bottom is of soft mud, nearly level, the depth in the original channel being not much greater than elsewhere. In 1861 there was a depth of 5 feet at low water in the channel leading up to Flushing, and in 1879 but 3.9 feet.

The mean rise of tide is 7.1 feet.

PROJECT FOR IMPROVEMENT.

A survey of Flushing Bay was made in 1878, and a project for improvement, based on it, was proposed and adopted, providing for the construction of a dike extending across the westerly part of the mouth of the bay and upon the west side of the channel to the head of the bay near Flushing, and a dike extending from a point near the middle of the east shore in a northerly direction to the 6-foot curve, and almost parallel to the first, in order to form a large tidal basin whose waters should ebb and flow through a narrow channel, with dredging to maintain a channel 6 feet deep at mean low water. The estimated cost for carrying out this project was as follows:

Constructing 4,400 linear feet of pile-dike, at \$10 per foot.....	\$44,000
Constructing 7,800 linear feet of pile-dike, at \$9 per foot.....	70,200
Constructing 900 linear feet of pile-dike, at \$7.50 per foot.....	6,750
Constructing 3,600 linear feet of single piling, at \$3.70 per foot	13,320
For 83,000 cubic yards of dredging, at 20 cents per cubic yard.....	16,600
Contingencies.....	22,000
Total	173,500

All the timber work of the dikes was to be creosoted.

Up to June 30, 1880, 3,057 linear feet of pile-dike were constructed on the west side of the channel from the head of the bay.

Subsequent appropriations, until 1889, have been wholly expended in dredging and redredging to make and maintain the required channel depth.

September, 1888, a modification of the original project was approved which provided for "extending the dike northward and towards the west side of the channel at College Point, and for dredging, omitting the dikes running westerly to Herrick Point, and the single row of piles on the east side."

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1889.

By act of Congress of August 11, 1888, \$15,000 were appropriated for this improvement, and in accordance with the above modification of project, after due advertising, a contract was entered into, June 4, 1889, with Henry Du Bois' Sons for building about 1,600 feet of pile-dike and for dredging about 15,000 cubic yards. Work under this contract was begun June 27; at the close of the year 375 piles of the pile-dike had been driven; the contract expires November 1, 1889.

PRESENT CONDITION OF IMPROVEMENT.

The part of the dike built in 1880, 3,057 feet long, has settled from a few inches to a foot.

The channel up the bay, which has been dredged 6 feet deep three successive times, has now rather less than that depth in places.

PROPOSED OPERATIONS.

Under the present contract the dike will be extended northward about 1,600 feet, and the channel depth of 6 feet will be restored and extended as far as practicable. With further appropriations it is desired to extend the dike and to dredge to widen the channel.

Appropriations for improving Flushing Bay, New York, have been made as follows:

Date.	Application.	Amount.
Mar. 2, 1879	Construction of dike.....	\$20,000
June 14, 1880	Dredging.....	15,000
Mar. 2, 1881	.....do.....	10,000
Aug. 2, 1882	.....do.....	5,000
July 5, 1884	.....do.....	10,000
Aug. 5, 1886	.....do.....	10,000
Aug. 11, 1888	Construction of dike and dredging, not yet expended.....	15,000
	Total.....	85,000

Flushing Bay is in the collection district of New York. The nearest light-house is on North Brother's Island. Fort Schuyler is the nearest work of defense.

Money statement.

July 1, 1888, amount available.....	\$1,020.26
Amount appropriated by act of August 11, 1888.....	15,000.00
	<hr/> 16,020.26
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$65.69
July 1, 1889, amount covered by existing contracts.....	10,214.80
	<hr/> 10,280.49
July 1, 1889, balance available.....	5,739.77
	<hr/>
{ Amount (estimated) required for completion of existing project.....	88,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	35,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

732 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

Abstract of proposals for improving Flushing Bay, New York, opened at Engineer Office, U. S. Army, New York City, April 18, 1889.

Number.	Name and address of bidder.	Pile dike (1,000 linear feet).							Dredging rate per cubic yard (6,000 cubic yards).	Amount of bid.
		Piles driven, per linear foot (110 linear feet).	Yellow pine per M. (870 feet E. M.).	Oak wale per M. (150 feet E. M.).	Screw bolts per pound (74 pounds).	Drift bolts per pound (9 pounds).	Splices per pound (17 pounds).	Total amount for 10 linear feet.		
1	James Du Bois and Abraham Du Bois, New York City*.....	\$0.11	\$30.00	\$50.00	\$0.04	\$0.04	\$0.04	\$45.00	\$0.20	\$10,214.00
2	A. D. Davis, Jersey City, N. J. ....	.21	38.00	45.00	.04	.02	.02	62.67	.20	12,227.00
3	William H. Morton, New York City	1.52	37.00	50.00	.05	.03	.05	206.91	.17	35,556.00
4	P. Sanford Ross, Jersey City, N. J. ....	.20	36.00	55.00	.04	.04	.04	69.09	.20	12,614.00
5	Richard Parrett, Newburgh, N. Y. ....	.17	45.00	60.00	.06	.05	.05	66.63	.20	12,680.00
6	John Kelly, Brooklyn, N. Y. ....	.13	43.00	48.00	.05	.04	.04	58.57	.23	12,870.00
7	John Gillies, New York City .....	.15	35.00	43.00	.04	.03	.03	58.30	.21	11,085.00

* Entered into contract June 4, 1889; in progress.

COMMERCIAL STATISTICS ESTIMATED FOR CALENDAR YEAR OF 1888.

Arrival and departure of vessels.

Kind.	Number.	Tonnage.
Steamers	890	115,000
Sailing vessels	878	43,300
Barges, etc.	723	182,000
Total	2,491	340,300

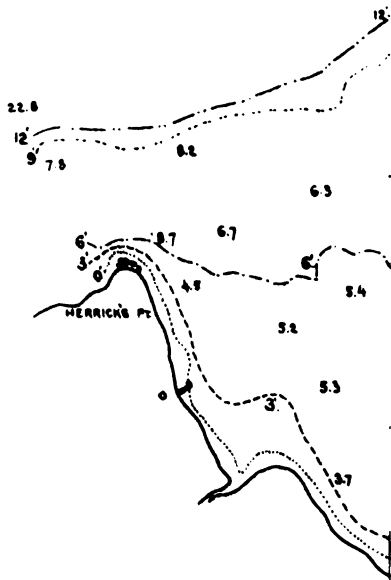
Draught 5 to 9 feet. Tonnage 20 to 300 tons.

Cargoes.

	Tons.	Value.
Shipments	125,475	\$3,182,400
Receipts	83,700	2,502,425
Total	209,175	5,684,825

The principal articles of commerce are manufactured goods, coal, grain, building materials, and general merchandise.

LONG ISLAND



1889.

Flushing Bay,
N.Y.

Condition of Improvement
June 30, 1889.

Scale.



Report.

Colonel of Engineers.

D 21.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

WRECK IN HEMPSTEAD BAY, LONG ISLAND, NEW YORK.

About midnight, August 10-11, 1888, the *Bay Ridge*, a side-wheel passenger steamer, 205 feet long and 32 feet beam, caught fire while lying at her dock at Glenwood, Long Island, N. Y., and parting her lines, drifted out with the ebb current and sank in about 20 feet depth of water in the channel on the west side of Hempstead Bay, after burning to the water's edge. The wreck was reported as an obstruction in September, 1888, but no action was then taken, because her owner made a private contract for her removal, which the contractor reported completed in December, 1888, so that no part was left projecting more than 2 feet above the bottom.

In April, 1889, complaint was made that the wreck had been struck by passing vessels, and an examination showed that some timbers were standing at not over 9 feet depth at low tide. The cost of complete removal was estimated at \$2,500, which was allotted, and the removal authorized. The wreck is now marked by a buoy placed by the Light-House Department June 5, 1889, the notice to owners or parties interested, as required by law, was published, and it is expected to advertise proposals for removal early in the current fiscal year.

D 22.

PRELIMINARY EXAMINATION OF FORT POND HARBOR, MONTAUK, NEW YORK.

ENGINEER OFFICE, U. S. ARMY,
New York, December 10, 1888.

GENERAL: I have the honor to submit the following report on a preliminary examination of Fort Pond Harbor, Montauk, N. Y., made in pursuance of the river and harbor act of August 11, 1888, and directed by letter from the Chief of Engineers, dated August 28, 1888.

Fort Pond Bay lies on the north side of Long Island, about 6 miles west of Montauk Point. The following description is given in the United States Atlantic Coast Pilot:

From Shagwong Point the trend of the shore is W. $\frac{1}{2}$ S. for 2 $\frac{1}{4}$ miles to Culloden Point, and is composed for the most part of low sandy lands and many sand hillocks, covered with grass, and at long intervals a few trees. Culloden Point is somewhat higher than the land to the eastward of it, but is also sandy, bare of trees, and covered only with a sparse growth of grass. At this point the shore turns abruptly and runs S. $\frac{1}{2}$ E. for 1 $\frac{1}{4}$ miles, then sweeps with a regular curve around to the westward and northwestward, thus forming a large semicircular indentation called Fort Pond Bay. From Culloden Point the eastern shore of this bay is composed of hills of moderate height, separated by small valleys intersected by ravines, which give the land an undulating appearance. The country appears barren and desolate, *there being no settlements*, and the only growth a thin grass. At the head of the bay the shore is low and flat, but its western shore is higher, and shows thick groves of trees here and there. Fort Pond Bay is $\frac{1}{4}$ miles wide, has a depth of from 4 to 8 fathoms, and affords excellent shelter in southerly and easterly weather. The holding ground is good, and the harbor perfectly unobstructed, it being only necessary to keep about a quarter of a mile from either shore.

Rocky Point is the western point of entrance to the bay, and is $1\frac{1}{2}$ miles to the southwestward of Culloden Point. It is low and covered only with grass, with a few trees on the higher lands back of the point and a fringe of rocks along the bay shore.

First Lieut. James O. Sandford, Corps of Engineers, reports as follows:

Fort Pond Bay is an indentation of the north shore of the Montauk Peninsula, and is about $\frac{1}{2}$ mile west of Montauk Point, the eastern extremity of Long Island. The headland at the east side of the entrance is known as Culloden Point, and that on the west side Rocky Point, Culloden Point projecting nearly a mile further north than Rocky Point. The bay is semi-elliptical in form, being about $1\frac{1}{2}$ miles wide (northeast and southwest), and, measuring from Rocky Point, seven-eighths of a mile long (northwest and southeast). The depth of water varies from 0 to $49\frac{1}{2}$ feet at mean low water, there being over an area of 420 acres a depth of from 5 to $8\frac{1}{2}$ fathoms. The shore on each side of the bay consists of sand bluffs, from 35 to 50 feet in height, sloping back to 60 feet in height, intersected by numerous valleys, the western shore being wooded, except in the valleys, while the eastern shore is covered only with grass. The ridges on each shore extend, approximately, north and south, joining an east and west ridge (on which the carriage road is built) near the south shore of the island. At the south end of the bay is a sand beach, from 3 to 5 feet above mean high water, which separates the bay from Fort Pond. Of the valleys mentioned above, there are four on the west side of the bay. The first valley is about 200 feet south of Rocky Point, and is about 50 feet wide, sloping gently to the rear. It descends to about 15 feet above the bay and terminates in a low bluff. The second is about 600 feet south of Rocky Point. It is about 400 feet wide at the bay, widening to the rear, 10 feet above high water at the eastern end, and 800 feet long, thence sloping gently back to a height of 40 feet. Its side-slopes rise to only about 20 feet. The third valley is about 1,200 feet south of Rocky Point. It is 150 feet wide, 10 feet above high water at its eastern end, and slopes upward somewhat rapidly to the rear. The fourth valley is about 2,500 feet south of Rocky Point. It is about 600 feet wide at the bay, widening to 800 feet and forming two branches at the rear, is about 600 feet long, sloping back and on the sides to a height of 50 feet. At the bay it is only about 4 feet above high water, and for a length of 100 to 150 feet next back from the shore has a somewhat less height. A preliminary survey for an extension of the Long Island Railroad to Fort Pond Bay was made in 1882. The line then surveyed passes near the head of the second valley, and near the mouth of the fourth. From Napeague Bay to Fort Pond Bay the line passes near the north shore of the peninsula. The grades are easy throughout, and the soil is well suited for excavations and embankments. Either of the two valleys last mentioned is well suited for a railroad terminus, the area of either being probably sufficient for the buildings that would be required, and having a good water front from which to build docks extending into the bay. If necessary, both valleys could be used for the terminal building, thus affording ample room for a large railroad business. Of the two valleys the one nearest Rocky Point (the second) appears to me preferable for a terminus, as its sides, being lower and less steep than those of the fourth, could be more easily excavated if necessary, and that part of the bay immediately in front of it could be more easily sheltered.

The bottom of the bay consists of hard sand and bowlders from the shore to the depth of 25 feet at mean low water. Outside of this depth the bottom is of mud underlaid by hard sand. The mud is said by the fishermen of the bay, who drive stakes for pound-nets in 30 to 35 feet of water, to have a quite uniform depth of 3 feet over the deep-water area (30 feet depth and over) of the bay. It is said that the anchors of vessels anchoring in deep water in the bay often sink through the mud and bring up hard sand on the flukes. From Rocky Point outwards there are more bowlders on the bottom than elsewhere. They are said to be quite numerous here out to a depth of 35 feet.

At Fort Pond Bay there is no commerce and the only demand for its improvement is by parties who propose to make it the terminus of a line of transatlantic steamers, at which passengers and freight could be transported by rail to New York. This involves an extension of the Long Island Railroad a distance of about 28 miles. This would make a saving of about 120 miles by water, but would involve 124 miles of railroad transportation and the ferry crossing the East River to reach New York City. To make this bay a safe landing place for steamers at all times would involve the construction of works to protect it from storms from northeast to the northwest. The most economical plan

which suggests itself is to construct a breakwater from Rocky Point in a direction about east-northeast and about 2,000 feet in length, and one from a point on the eastern shore, about half a mile from Culloden Point, in a direction about west and about 1,200 feet in length. These should be constructed of riprap, with the following dimensions, viz:

The top to be 12 feet wide and 6 feet above mean high water, with outer or seaward slope of 1 on 2 and the inner slope 1 on 1, and the estimated cost is as follows:

Breakwater at Rocky Point, 295,000 tons of stone at, \$1.40	\$413,000
Breakwater from eastern shore, 93,000 tons of stone, at \$1.40	130,200
Contingencies.....	56,800
Total	600,000

In order to enable a report to be made as to whether the harbor is worthy of improvement in view of the present and prospective demands of commerce, I have addressed a letter to Mr. Austin Corbin, who represents the parties interested in the establishment of a line of fast steamers to run from Milford Haven, on the west coast of Wales, to Fort Pond Harbor; also to leading lines of steam-ships crossing the Atlantic, and to the Chamber of Commerce of New York City. Their replies as far as received are appended to this report.

The advantages claimed for this route are a saving of time by the substitution of 124 miles of railroad transportation for 120 miles of ocean transportation, the avoidance of delays at Sandy Hook entrance to New York Harbor on account of tides and fogs, and greater security from accidents by avoiding the tracks of vessels converging toward New York Harbor. The saving of time due to railroad transportation would probably not exceed three hours, and this would be reduced by the time required for landing passengers and baggage, examination of the latter by the custom-house officers, and delays at the ferry over the East River. I do not think the saving of time on account of railroad transportation would be an inducement to passengers to take the Fort Pond route, with a railroad journey of 124 miles and a ferry crossing. The Government is now engaged in improving the Sandy Hook entrance to New York Harbor, with a view to obtaining a depth of 30 feet at mean low water. When this is accomplished there will be no delays on account of depth of water. As to fogs, it does not appear that they are more prevalent near New York than in the vicinity of Montauk, but it is not probable that they would cause much delay in entering Fort Pond Bay, as the approaches are of ample width and depth.

For further particulars as to the advantages or disadvantages of the proposed route, I would refer to the accompanying letters. It seems to me that any advantages claimed for Fort Pond Bay exist at other points. New London Harbor has a depth of 27 feet at mean low water, and could be deepened to 30 feet at comparatively small expense. It is 124 miles by rail to New York, without any ferry. The western passage of Narragansett Bay has a depth of 30 feet up to Dutch Island, and the construction of a few miles of railroad on the western shore would connect a landing with the New York, Providence and Boston Railroad. The saving in water transportation would be greater than at Fort Pond. The experiment might be tried at either of these points without calling upon the Government. If greater saving in water transportation is desired, harbors are available further east on the New England coast.

From all the information I can collect it appears that the establishment of Fort Pond Bay as the terminus of a line of transatlantic steamers would be an experiment of doubtful success even if all the require-

ments of a harbor there were fulfilled, and in view of the great cost of necessary improvements and the absence of any general demand for them, I do not think the Government would be warranted in expending money on such an experiment. I have therefore to report that, in my opinion, the harbor is not worthy of improvement, in view of the present and prospective demands of commerce.

I inclose a tracing from the Coast Survey charts of Fort Pond Bay, showing the location of works above referred to.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

LETTER OF MR. A. M. UNDERHILL, AGENT.

GUION LINE LIVERPOOL STEAMERS,
New York, September 29, 1888.

DEAR SIR: I have the honor to acknowledge receipt of your circular of 25th instant.

No matter how much "improvement" might be made in Fort Pond Harbor I can not conceive any practicable combination of circumstances that could possibly induce the owners of fast ocean steamers to make such a location the terminus of a line.

Respectfully, yours,

A. M. UNDERHILL.

Lieut. Col. D. C. HOUSTON,
Corps of Engineers, U. S. A.

LETTER FROM MR. AUSTIN CORBIN.

NEW YORK, October 6, 1888.

In reply to your letter of inquiry with regard to Fort Pond Bay, I beg to say that it is important to my mind that that should be improved and opened as a port, and for the following reasons:

As you will see by the map inclosed, there is a depth of water within 300 feet of the shore of not less than 30 feet at low tide. This depth gradually increases until it reaches 50 feet and upwards. The entrance to the harbor would be between Montauk and Block Island lights, and so far as I have been able to discover there are no serious objections to the route as a proper channel for passage of ships of the largest size. The size and tonnage of passenger and freight ships, as you are aware, has been very largely increased during the last ten years, until now the largest and most popular passenger ships draw so much water by reason of the weight of their machinery, etc., that it is impossible for any one of them to cross the bar in New York Harbor at low tide. Delays occur there frequently of from 12 to 18 hours. For instance, a vessel passing Montauk Point at 9 o'clock in the morning could not possibly discharge her passengers in New York with the tides in her favor before late the same evening, and if the tide was against her it would be impossible to discharge these passengers before from 1 to 3 hours after sunrise the next morning; whereas with this open port at Fort Pond, practically 150 miles from New York, every one of these large vessels could enter at any hour, discharge her passengers at once, and in two and one-half hours they would be in New York City.

The object of the people I represent is the establishment of an express line of steamers for the carriage of passengers, mail and fast freight (that which pays the best prices), quickly between the two cities of New York and London. We desire on this side the use of the bay at Fort Pond and on the other at Milford Haven. The Long Island Railroad is completed to within 28 miles of Fort Pond, and the line has already been surveyed and located to cover this distance, and the company will have it constructed and ready for operation the moment this port is opened.

The water transportation on this side would thus be shortened 150 miles, and the passage of these fast ships in the track of all incoming and outgoing shipping of New York avoided. They would simply cross the track of such shipping and within half an hour be in the harbor.

On the other side, I am informed the works at Milford Haven are already completed; that they have in the docks at low tide a depth of 30 feet, and at the entrance to the harbor not less than 10 feet. My impression is they claim 60 feet. On that side the present route via Liverpool is a long detour to reach London. St. George's Channel is full of shipping at all hours of the day and night, and the passage from Fasnet to Liverpool, as well as that from Montauk to Sandy Hook, is considered particularly dangerous. This route of ours would strike a little south of Fasnet Light, and pass on a nearly direct line to Milford Haven. It avoids 150 miles of water transportation on that end and the dangers of the channel.

I beg to hand you herewith a very simple map showing the routes on other side on a small scale. It is accurate, being reduced from a larger and standard one.

I beg to copy, for your information, from a letter written two or three years ago to gentlemen in London upon this subject, which will perhaps state the case from my stand-point as clearly as I could repeat it now.

Some little time ago I had examined the question of the foreign ocean steam-ship tonnage entering the port of New York, during the years 1860, 1870, and 1880, which will give you an idea of the enormous increase of this business, and the necessity of furnishing proper facilities for it.

Yours respectfully,

AUSTIN CORBIN.

Lieut. Col. D. C. HOUSTON,
Corps of Engineers, U. S. A.

Foreign ocean steamship tonnage, port of New York.

Year.	Entered.	Cleared.
1860*.....	617, 147	622, 419
1870.....	1, 342, 909	1, 457, 159
1880.....	3, 902, 480	3, 960, 288

* Steam and sail combined.

EXTRACT FROM LETTER REFERRED TO IN FOREGOING COMMUNICATION.

The population of the United States alone is over 60,000,000 people, and that of the United Kingdom over 36,000,000. The introduction of some means of rapid transit between these two great English-speaking nations, as well as with the continent wholly free from the inconveniences, delays, and hazards due to tides, fogs, and storms encountered in narrow and crowded water-ways, and along dangerous coasts such as beset the present routes, has long been considered a growing necessity. This necessity it is the object of the present line to meet. The port of departure in Great Britain will be Milford Haven and that in the United States Montauk Bay, on Long Island, both of which are deep harbors without bars or other obstructions, and free from all the objections here enumerated.

Since the commencement of steam-ship navigation the traffic between the two continents has more than kept pace with the increase of accommodation.

- This experience proves that the same relations of cause and effect which subsist between improvements in comfort and speed, and reduction of expense, on the one hand, and increase of traffic on the other over extended lines of railway, apply with equal certainty and force on important ocean highways. Saving one-third the time required for the delivery of mails and the transit of passengers and freight may be expected to exert an influence sufficient to nearly or quite double the correspondence, business, and travel. It is not believed that any diminution of traffic over existing lines will result from the operation of this. On the contrary, it is believed that the increased intercourse between the two countries arising out of its establishment will more or less benefit them all.

The dispatch of the royal mail through Ireland to Queenstown, instead of meeting the requirements above recited, makes the period of transit considerably longer than it would be via Liverpool, if the approach to that harbor permitted even such ships as are at present employed to sail directly from their pier at any given hour, irrespective of tides.

An arrangement for existing lines to call at Holyhead to receive and discharge mails and passengers would be better than the present method, saving from five to

eight hours in time over the route via Queenstown; but this would also fail to meet the requirements named. There would still remain the perils and delays of the tidal harbor of New York, of St. George's Channel, and of a port, the approach to which by ships of great draught would be difficult, and at times dangerous, and in which the area of deep water is limited and landing inconvenient. There would also remain the difference of nearly 300 miles in sailing distance. The importance of this difference in distance will be recognized when it is remembered that it represents more than half a day in time, and that a similar gain of 100 miles in the Mediterranean is held to justify the construction of a canal across the isthmus of Corinth.

The gain in sailing distance is about 170 miles at one end of the route, avoiding the inclosed waters and currents of St. George's Channel, and 118 miles at the other end, avoiding the dangerous coasts of Long Island and New Jersey, about 288 miles in all, or from fifteen to twenty hours steaming at the rate usual in those seas.

In addition to the specific and constant advantages peculiar to this route there exist extraordinary and occasional ones arising out of exemption from the dangers described in the second paragraph, dangers to which most of the accidents encountered by the Liverpool and New York lines are attributable.

By the proposed route limited mail and express trains would leave London for Milford Haven at stated hours throughout the year, connecting under cover on the pier with the steam-ships lying alongside. The latter will also be timed to sail at a fixed hour, but will, in all cases, await the arrival of the trains with which they are "in correspondence." In thirty minutes they will be in the open ocean.

At Montauk Bay an express train standing on the pier will await the arrival of the ship, and will start for New York in thirty minutes, or as soon thereafter as the transfer of mails and passengers can be effected.

All delay, local transportation, and hotel charges at either end will thus be avoided, and a cheap fixed service established between Great Britain and America, almost as definite and regular in time, and as convenient in execution, as between London and Paris.

Arrangements to this end will be made with the Milford Dock Company and with the Great Western and Long Island Railways, and it is intended to form a connection with the great railway systems running to all parts of the United States. It will then be practicable to travel from London to San Francisco, Cal., a quarter of the way round the world, without entering a hotel, calling a local conveyance, or walking more than 60 yards.

Both Milford Haven and Montauk Bay carry 40 feet of water to the point of embarkation, so that the ships of this line can be of the largest size, with a draught of 30 feet. This will facilitate the attainment of greater speed than is possible to those of existing lines, which, being constructed for the tidal harbors of New York and Liverpool, have long since reached a draught of 26 feet, the maximum possible at these ports, and by giving the builder greater freedom in construction, will enable him to guarantee that an average rate of 20 knots or more per hour can be maintained, and greater steadiness of motion secured.

The ships will be built in the best manner and of the best material known. Every device tending to ensure the safety and comfort of passengers, and the maintenance of schedule time will be adopted. They will be constructed in water-tight divisions, so as to render them incapable of sinking from collision or any other casualty.

Special attention will be given to improvements in internal construction, and state-rooms will be arranged in suites, or with dressing-rooms attached, as well as singly, so that those requiring them can enjoy all the conveniences and privacy procurable at first-class hotels in London or New York. Provision will be made for about 500 cabin passengers.

The heavy port, pilot, and other charges at Liverpool and New York are items of great expense to the present lines. At Montauk Bay and Milford Haven, these will be on a very moderate scale, and it will be easy to arrange ample accommodation for embarking and landing passengers and their luggage. The latter will be checked (registered) through from the chief cities and towns of either country to those of the other.

LETTER FROM MESSRS. VERNON H. BROWN & CO., AGENTS OF THE CUNARD STEAM-SHIP COMPANY, IN REGARD TO FORT POND HARBOR, MONTAUK, N. Y.

NEW YORK, October 31, 1888.

DEAR SIR: We duly received your circular bearing date of September 25, requesting us to furnish you with our views as to the eligibility of above-described place as the terminus of a line of fast ocean steamers.

In reply we would say that we fail to see any advantage to be derived from such a scheme.

Fort Pond Harbor, practically, is but a harbor in name, and to make it available as a port of entry for large ships would require enormous expenditures, which the Government should not properly be called upon to do for individual interests.

In approaching Fort Pond Bay there is a danger (Southwest Ledge) off Block Island, and another (Phelps' Ledge) off Montauk Point; these dangers are about west-southwest and east-northeast from each other, and distant $7\frac{1}{2}$ miles; both are marked, the former with a whistling buoy and the latter with a black buoy; both dangers are about east-northeast from Montauk Point. About northwest by north, 4 miles off the same point, lies Shagwong Reef, marked with a bell-boat. A vessel bound for Fort Pond Bay must, after passing this reef, steer southwest before entering the bay. In clear weather there is not the slightest difficulty, but during thick weather there would be great risk in approaching the harbor. Fort Pond Bay is open to winds from west-northwest to north, and unless a long breakwater were built the landing with strong winds would be difficult, and during gales impossible.

It has been advanced by the advocates of this measure that there was less liability to fog in approaching Fort Pond Bay than in approaching New York Bay, but we have never found a seafaring man familiar with the coast that would indorse such a statement; in order, however, to obtain reliable data on this subject, we have caused the log-books of the Cunard steamers engaged in the New York service for the past ten years to be examined, and they show that in approaching or leaving Sandy Hook, passing Montauk Point about 24 miles to the southward when west bound, and about 30 miles to the southward when east bound, there has been experienced during the eight months ending November 30, six times as much fog between the meridians of seventy-one degrees and seventy-three degrees as there was to the westward of the seventy-third meridian during the other four months; the proportion is about three to one against Fort Pond and in favor of New York.

In talking with one of our most experienced captains he stated from his own observation that there is a far greater proportion of fog near Montauk Point than off Fire Island and to the westward, and that he had no hesitation in asserting that there would be much longer detention from fog alone in trying to enter Fort Pond Bay than in getting into New York.

The satisfactory work done under the supervision of the United States Engineers in dredging out the Gedney Channel and in generally deepening and improving all the channels and approaches to New York, and which we are informed by Capt. Geo. McC. Derby, the able officer now in charge of this work, gives an uninterrupted channel of $27\frac{1}{2}$ feet from sea to dock at low water. This has remedied to a great extent the grounds of complaint that heretofore existed in that respect, and when this great and needed work is completed, giving us a continuous channel of 30 feet depth at low water, we shall have a harbor second to none on the coast, and sufficient to meet all requirements of commerce of the great State of New York.

In considering the propriety of making Fort Pond Bay a port of entry, it must be remembered that this would necessitate the organization of customs, quarantine, etc., and the maintenance of a large staff of employes, all of which would have to be paid for by the Federal Government and the State of New York, making, with Greenport (almost within stone's throw), two insignificant ports of entry, when there is not business enough for one.

Owing to the bleak and exposed position of Long Island, the railroads are subject during the winter months to interruptions and serious delays by storms, snow, and ice.

Any attempt to run a line of ocean steamers in the winter, making Montauk Point the terminus, would not only fail from lack of patronage, but from inability to overcome the natural obstacles alluded to.

The claim that passengers and mails can be landed in New York quicker via Fort Pond than by coming direct to New York is absolutely incorrect and untenable. The time required by the fast steamers to run between the point of deviation off Montauk and quarantine station at New York, would be, under ordinary circumstances, five hours. It certainly does not require much calculation to show that *from the point of divergence* a steamer could not get into Fort Pond Harbor, land passengers, baggage, and mails, reload them in cars, run the whole length of Long Island, and get across the ferry to New York City in equally quick time.

We have not taken into account the time necessary for examination of baggage by customs, and inspection of passengers by health officer at Fort Pond Harbor, which would cause a delay to mails and passengers of about four hours, as train must wait until all baggage had been examined, whereas at New York the mails are promptly sent to post-office, and passengers may start for their homes as soon as their individual baggage is passed by customs.

Yours truly,

VERNON H. BROWN & Co.

Lieut. Col. D. C. HOUSTON,
Corps of Engineers, U. S. A.

LETTER FROM MESSRS. PETER WRIGHT & SONS, AGENTS OF THE INMAN LINE.

INMAN AND INTERNATIONAL STEAM-SHIP COMPANY,
New York, November 3, 1888.

DEAR SIR: We have very carefully considered your communication regarding the eligibility of Fort Pond Bay, Montauk, N. Y., as the terminus of a line of fast ocean steamers. We are inclined to believe that the expense of making this harbor a proper terminus for fast transatlantic steamers, which would necessarily be of the largest class, would be so great as to be out of proportion to the business likely to be attracted to that point by such improvements.

We are informed that the approach to the eastern entrance to Long Island Sound is dangerous for vessels of the class referred to, and that heavy fogs are very frequent in that region. We do not think that a pilot service able to take proper care of the vessels likely to engage in the trade from Europe to Fort Pond Bay can be built up without great cost and considerable time.

We can not imagine any national advantage in the establishment, at great expense, of a harbor for ocean steamers so near the great harbor of New York, upon which the Government has spent, and is spending, large sums to maintain its suitability for the business of the largest vessels afloat.

Yours, very truly,

PETER WRIGHT & SONS.

Lieut. Col. D. C. HOUSTON,
Corps of Engineers, U. S. A.

LETTER FROM MESSRS. OELRICHS & COMPANY, AGENTS OF THE NORTH GERMAN LLOYD STEAM-SHIP COMPANY.

NEW YORK, November 15, 1888.

DEAR SIR: We beg leave to acknowledge receipt of your valued favor of 14th instant, and in reply would say that we are hardly competent to express an opinion as to the suitability of Fort Pond Harbor, Montauk, N. Y., as a harbor for large ocean steamers.

With regard to the eligibility of the harbor as the terminus of a line of fast ocean steamers, our experience as passenger and freight carriers across the ocean would qualify us to express the emphatic opinion that a line of ocean steamers landing freight and passengers at Montauk Point, instead of in New York City, would be a decided failure.

We are, dear sir, yours, very truly,

OELRICHS & COMPANY.

Lieut. Col. D. C. HOUSTON,
Corps of Engineers, U. S. A.

LETTER OF MESSRS. HENDERSON BROTHERS, AGENTS OF THE ANCHOR LINE.

NEW YORK, November 16, 1888.

DEAR SIR: We have your favor of the 14th instant relative to Fort Pond Harbor, Montauk, N. Y., and regret that your circular of the 25th September had been overlooked.

We have seen the very full and able report made to you by the agent of the Cunard Line on this subject, and there is but little, if anything, left for us to say further than that we quite agree with, and fully indorse, the views expressed therein.

Most respectfully, yours,

HENDERSON BROTHERS.

Lieut. Col. D. C. HOUSTON,
Engineer Office, U. S. A.,

LETTER FROM MR. J. BRUCE ISMAY, AGENT WHITE STAR LINE.

WHITE STAR LINE,
New York, November 27, 1888.

SIR: I beg now to reply to your circular dated September 25, with regard to the eligibility of Fort Pond Harbor as a terminus for fast ocean steamers. I think that whatever may be the advantages of the aforesaid harbor, in respect of depth of water, absence of tide, area, etc., of which I am unable authoritatively to write, it is not feasible to attempt to make it a terminus for ocean steam-ships. This, it seems to me,

will always be determined naturally, and will be where freight, passengers, labor, and supplies can be obtained with the greatest facility and at least cost. In Fort Pond Harbor all these facilities will have to be made in opposition to those already existing in New York without the possibility of any corresponding advantage. As a port of call, Fort Pond being only 120 miles from New York, it is scarcely probable that any steam-ship company would incur the necessary expense and detention required to disembark passengers and their baggage for a distance so short, with no gain of time to the passenger, and such loss and risk to the steam-ship.

The additional tax on commerce and travelers would be great, and also on the revenue of the country. There would have to be a railroad, an additional custom-house, with all the numerous requirements and expensive adjuncts of a first-class port. All this expense would be for the purpose of carrying passengers 120 miles by land.

Several attempts have been made to change the existing avenues of commerce by improving ports and offering facilities for ships. Notably the ports of Milford and Falmouth in England, where large sums have been spent only to prove the attempts failures.

I am, sir, yours respectfully,

J. BRUCE ISMAY.

Lieut. Col. D. C. HOUSTON,
Corps of Engineers, U. S. A.

D 23.

PRELIMINARY EXAMINATION OF BLACK ROCK HARBOR, FOR BREAKWATER TO PENFIELD REEF AND SOUTH FROM FAIRWEATHER ISLAND, CONNECTICUT.

ENGINEER OFFICE, U. S. ARMY,
New York, October 30, 1888.

SIR: I have the honor to submit the following report of a preliminary examination of "Black Rock Harbor for breakwater to Penfield Reef and south from Fairweather Island," made in pursuance of the river and harbor act of August 11, 1888, and directed in letter from the Chief of Engineers, dated August 28, 1888.

Black Rock Harbor is on the north shore of Long Island Sound, about 3 miles west of Bridgeport, Conn. It consists of a bay about 2 miles long (north and south) by 1 mile wide; it is sheltered on the north and west by the mainland; partially sheltered on the south by Fairfield Bar, but is open towards the east except the upper part which is protected by Fairweather Island. This upper portion affords a good harbor for vessels of not over 9 feet draught. The lower portion has anchorage ground for vessels of 20 feet draught but is exposed to easterly storms through the opening between Fairweather Island and "Little Cows" (a cluster of bowlders at the north end of Penfield Reef), about a mile long.

The general character of the bottom is sand near the shore and out to about 15 feet depth, beyond which it is mud; it is considered good holding ground. The mean rise of tide is $6\frac{1}{2}$ feet. There is a light-house near the south end of Fairweather Island, and another near the south side of Penfield Reef.

In 1883 a survey of Black Rock Harbor was made (see Annual Report of the Chief of Engineers for 1884, page 665) under which a project was adopted for improving the channels leading into the upper part of the harbor; work under this project is not yet completed.

It is understood that this examination is for the purpose of making estimates for a breakwater extending south from Fairweather Island toward Penfield Reef so as to increase the anchorage area. If extended to Penfield Reef it would entirely close the harbor.

The proper course for a breakwater extending south from Fairweather Island would seem to be directly towards "the Little Cows,"

about 5 degrees west of true south. The most economical construction would undoubtedly be of riprap, and the exposure being about the same as at New Haven, the same dimensions should be used, viz., top 12 feet wide and 6 feet above high water, inner slope of 1 on 1, and outer or seaward slope, 1 on 2. If this breakwater were made 4,000 feet long, it would shelter from southeast storms an area of about 100 acres having at least 12 feet low water depth, nearly one-half of which would be 18 feet deep or over; the area sheltered from any other quarter would be as great or greater.

To make the shelter from south and southwest complete, there would be required in addition a wall of riprap or of roughly placed stone along Fairfield Bar, which rises about 3 feet above mean low water, bending near its eastern end and extending to cover "the Little Cows." Shoal water south of Fairfield Bar would to some extent lessen the force of the seas, and 8 feet top width and 4 feet above high water with side slopes of about 1 on 1 would be sufficient cross-section for this work, which would be 7,700 feet long.

It would increase the degree of shelter and the area of harbor more than in proportion to the additional cost, particularly in case of southeast storms, if the breakwater were extended northeasterly from "the Little Cows" about 1,500 feet.

The cost of the work above outlined would be \$1,025,000.

For breakwater extending 4,000 feet nearly south from Fairweather Island, 355,650 tons of riprap, estimated to cost.....	\$565,000
For breakwater extending along Fairfield Bar from the mainland to "the Little Cows," 7,700 feet long, 74,666 tons of riprap, estimated to cost ..	190,000
For breakwater extending from "the Little Cows" northeastwardly, 1,500 feet long, 180,000 tons of riprap, estimated to cost.....	270,000

Total estimated cost.....\$1,025,000

This would make a safe and accessible harbor whose area of 12 feet depth or over would be 250 acres, nearly half of which would have 18 feet depth, with about 60 acres 20 feet deep.

The additional expenditure of \$270,000 over \$775,000 would increase the sheltered area 100 to 250 acres.

The commerce interested in a harbor of refuge at this locality is all that which goes through Long Island Sound to or east of Bridgeport, excluding the comparatively small amount that is carried on between ports east of Bridgeport.

The following estimates are based upon those presented in the annual report for 1887, for the several harbors along the Sound; they were compiled with care, and refer to the calendar year of 1886; the amount of commerce increases each year.

Vessels passing Black Rock Harbor in 1886, 78,500. This includes 52,592 observed to pass New Haven breakwater, and 15,939 entering Bridgeport Harbor; nearly all of these would pass Black Rock, besides others in night or thick weather which would not be observed.

The amount and value of commerce at principal Long Island Sound ports east of Black Rock in 1886, was estimated as follows:

	Amount.	Value.
Thames River and New London.....	Tons. 900,000	\$12,000,000
Connecticut River.....	900,000	64,000,000
New Haven.....	2,100,000	114,000,000
Bridgeport.....	1,100,000	77,000,000
Total.....	5,100,000	267,000,000

Probably 90 per cent. of this commerce goes through the sound to or from New York Harbor, and this does not include that which goes beyond Long Island Sound, which would probably make the amount double.

It should be observed, however, that perhaps half the tonnage and more than half the value is carried by regular lines of large steamers, which seldom seek harbors except in very foggy weather.

A large and increasing part of the commerce of Long Island Sound is carried in tows of barges and canal boats. These tows are frequently long and heavy, and in storms become unmanageable, and if they break from the tugs are generally lost. For commerce of this kind, more than for sail-vessels and steamers, frequent harbors of refuge are a necessity. There are small harbors, at not very great distances apart, along the north shore of Long Island Sound, the nearest one to Black Rock being Bridgeport Harbor, about 3 miles to the northeast, where a basin of 22 acres area 12 feet deep has been dredged on the west side of the channel to provide shelter for vessels driven in by storms. This area, as well as part of the main channel, is often occupied by vessels of moderate draught; vessels drawing over 12 feet can not enter Bridgeport Harbor when the tide is low. West of Black Rock the nearest harbor of refuge is behind Sheffield Island, near Wilson's Point, about 14 miles by water from Black Rock Harbor. There the anchorage ground for vessels of 15 feet draught or deeper is exposed on the south and west.

There is no doubt that transportation companies and vessel owners would be glad to have a harbor of refuge here, as they would at every other available point along Long Island Sound.

The question of a harbor of refuge on Long Island Sound, in view of the large expenditure needed, should not be decided from an examination of one locality; and I am of opinion that for a large and costly harbor, money can now be expended at other points than Black Rock with greater benefit to commerce.

An improvement, however, could be made at Black Rock Harbor, which would be of very considerable benefit, at much less cost than the above estimate. This would be done by making the breakwater from Fairweather Island only 1,500 feet long, and obtaining additional anchorage ground by dredging in the upper part of the harbor so as to give a depth of 12 feet over an area of 75 acres.

The estimated cost is as follows:

For breakwater 1,500 feet long, nearly south from Fairweather Island, to be 4 feet above high water, with top width of 8 feet, outer slope 1 on 2, inner slope 1 on 1, 43,475 tons of riprap, at \$1.75 per ton.....	\$76,081
Dredging 560,000 cubic yards at 12 cents per cubic yard.....	67,100
Contingencies, 10 per cent.....	14,328
Total.....	157,609

This plan admits of extension in the future. From the experience at Bridgeport there is every reason to believe that Black Rock Harbor, if improved, would be sought for safety by tows.

It is also probable that the business in the harbor will be greatly increased by the improvements which have and will be made in the channels connecting with the head of the harbor. This business belongs to the city of Bridgeport. I would therefore report that, in my opinion, the harbor is worthy of improvement.

No further survey is needed, as the Coast Survey chart of Black Rock Harbor of 1884 gives all the information needed at present for plans and estimates.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

D 24.

PRELIMINARY EXAMINATION OF NEW LONDON HARBOR, CONNECTICUT.

ENGINEER OFFICE, U. S. ARMY,
New York, November 20, 1888.

SIR: I have the honor to submit the following report of a preliminary examination of New London Harbor, Connecticut, made in pursuance of the river and harbor act of August 11, 1888, and directed in letter from the Chief of Engineers, dated August 28, 1888.

The necessary information has been collected by Mr. Henry N. Babcock, assistant engineer.

GENERAL DESCRIPTION.

The harbor is that part of the Thames River which lies in front of the city of New London, extending from Winthrop's Point to Long Island Sound, a distance of 3 miles, with widths ranging from one-fourth to 1 mile. It has a channel from 30 to 50 feet deep and of ample width, the 18-foot contours on opposite sides of the harbor being over 800 feet apart. The deepest water lies on the east side, opposite New London, and the principal wharves are separated from the main channel by a shoal of soft mud and sand 9 to 18 feet deep at mean low water.

New London Harbor is considered one of the best refuge harbors on the Atlantic coast; it is sought by vessels of every class when overtaken by stormy weather in the vicinity, and is also a regular rendezvous of the yacht clubs which cruise through Long Island Sound.

The mean rise of tide is $2\frac{1}{2}$ feet.

There is a naval station on the east bank of the Thames River about 2 miles above the city.

At Winthrop's Point a railroad bridge is now being built across the river.

New London, the port of entry for the collection district of New London, is situated on the west side of the harbor, the wharves being about $2\frac{1}{2}$ miles from the harbor's mouth.

Fort Trumbull, on the west shore, and Fort Griswold, on the east shore, command the harbor channel. There is a light-house at the harbor entrance on the west shore.

PREVIOUS IMPROVEMENTS BY THE UNITED STATES.

The only work done by the United States toward improving this harbor is the removal to 16 feet depth of part of a shoal lying east of the New London Northern Railroad wharf; this was begun in 1880 as part of the improvement of the Thames River, no previous survey hav-

ing been ordered, but \$2,500 from the appropriation for improving Thames River being specified as for that work. Subsequent appropriations were made for New London Harbor separately, the last one being made August 5, 1886, and the total appropriated amounting to \$19,800; the project was completed in November, 1886. The area dredged has not shoaled since.

DESIRED IMPROVEMENTS AND ESTIMATES OF COST.

The improvement desired now is distinct from that previously made; it consists in deepening part of the shoal between the city wharves and the main channel. It is represented that access to the wharves is seriously impeded by this shoal; that vessels of over 12 feet draught are compelled to wait for tides, and that then the deeper ones have to lighter before going to the wharves.

It is desired that so much of that shoal be removed as will make the approach to the wharves 15 feet deep at mean low water. The most economical way of accomplishing this would be by making a channel of that depth along the water-front at a short distance, say 50 feet, from the pier-heads, leaving the approach to each wharf to be dredged out by the owner; and this plan, I am informed, would satisfy the present needs of those desiring the improvement. The general form of the water-front is curved, convex to the river, and at the ferry near the middle of this curve there is now access to the deep water channel with more than 15 feet; if the improvement were made in this manner, vessels would come up to this point and then turn off either way to their wharves. To remove the entire shoal to 15 feet depth, so that after rounding Fort Trumbull Point vessels could head directly for their wharves, would be a more complete improvement; it would cost from three to four times as much as the other plan, and does not seem to be required at present.

To make a 15-foot channel at a distance of about 50 feet from the wharves, to be 200 feet wide and 3,000 feet long, extending from the upper end of the steam-boat wharf to Chappell's lower wharf, would require the removal of 84,000 cubic yards of material, principally mud and soft sand, at a cost estimated as follows, viz:

Dredging 84,000 cubic yards, at 16 cents per yard.....	\$13,440
Contingencies, inspection, etc.....	1,560
Total	15,000

COMMERCE TO BE BENEFITED.

The commerce that would be benefited by the desired improvement is nearly all (probably nine-tenths) of the local water commerce, and such through cargoes as are carried by the regular line of steamers to and from New York; also occasionally vessels running in for coal and water are obliged to receive them from lighters when with better depths they would take them directly from the wharves. All of the principal wharves would receive more or less benefit from such deepening of the approaches, except the New London Northern Railroad wharf, where the business is mainly through freights. The chief object for which the improvement is desired is the benefit to the commerce of the city of New London and its suburbs, including a population of about 1,000.

The following statistics show the amount of commerce by water that would be directly interested in such works of improvement. They are

compiled from detailed statements of the amount of business done at fourteen wharves, from Darow's wharf on the north to Chappell's wharves on the south. The detailed statements referred to nine months, from January 1, 1888, to September 30, 1888, but in the following table of totals $33\frac{1}{2}$ per cent. is added, to make the figures represent the annual commerce of these wharves.

Tons of freight received and shipped	272,800
Estimated value of such freight	\$3,679,300
Number of arrivals and departures of vessels	2,511

The draught of these vessels ranges from 9 to 18 feet; but few of them exceed 15 feet draught.

SUMMARY.

It is desired that the approaches to the several New London wharves be deepened so as to admit vessels of 15 feet draught at low tide, a work which would involve dredging about 84,000 cubic yards of mud and sand, at a total estimated cost of \$15,000. The amount of commerce that would receive benefit from such work is estimated at 272,800 tons per annum, valued at \$3,679,300, being the greater part of the commerce by water of the city of New London, and a not inconsiderable amount of through freight.

It is not to be understood that all of this commerce is now subject to detention by reason of shoal water; the larger part of it is carried by vessels which can go to the wharves without lightering. The trouble experienced results from the fact that all business now done at these wharves must either be done with light-draught vessels, or must be subject to delay while waiting for the tide or while lightering.

The accompanying sketch from the United States Coast Survey chart of 1884, scale $\frac{1}{200,000}$, shows the location of the desired improvement. No further survey is necessary for the purpose of making up a plan of improvement with fairly accurate estimate of cost.

In view of the amount of commerce to be benefited, I am of opinion that the harbor is worthy of improvement.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

D 25.

PRELIMINARY EXAMINATION OF MYSTIC RIVER, CONNECTICUT.

ENGINEER OFFICE, U. S. ARMY,
New York, October 26, 1888.

SIR: I have the honor to submit the following report on a preliminary examination of Mystic River, Connecticut, made in pursuance of the river and harbor act of August 11, 1888, and directed by letter of the Chief of Engineers, dated August 28, 1888.

The accompanying report of Mr. Henry N. Babcock, assistant engineer, gives a description of the river, an account of the present and prospective commerce, an estimate of the cost of desired improvement, and other information.

The business interests to be benefited by this improvement consist in ship-building, manufacturing, stone and silex quarrying, and the distribution of fuel and building materials over a district covering 15 square miles and containing 7,000 inhabitants. During the past year the value of freight and merchandise carried by vessels amounted to about \$400,000.

The channel from the mouth of the river to Mystic, a distance of 3 miles, while generally of sufficient depth, has several sharp bends which render navigation difficult for vessels of the increased length now in use. To remedy this difficulty the following estimate is submitted:

	Cubic yards.
Highway bridge to railroad bridge, 2,300 feet, deepening channel part of the distance	4,000
Railroad bridge to Oldfield ship-yard, 2,600 feet, deepening channel and reducing bend in upper 1,000 feet	35,000
Reducing bend just below Pine Hill Wharf	21,000
Reducing two bends at either end of the reach south of Sixpenny Island and just above Noank, or cutting a channel 100 feet wide through the lower bend, which would serve the same purpose with about the same amount of work	60,000
Reducing the bend at the mouth of the harbor between the harbor channel and the northeast channel	40,000
Total	160,000
One hundred and sixty thousand cubic yards of dredging at 16 cents per cubic yard	\$25,600
Supervision and contingencies, say	4,400
Total	30,000

To maintain these channels it is estimated that an average expenditure of about \$2,000 would be required.

In view of the amount of commerce to be benefited and the relatively small amount required for improvement, and from a personal examination, I am of opinion that the river is worthy of improvement.

Accompanying this report is a tracing from the Coast Survey chart of 1882, showing the depth of channel and the location of the desired improvements.

No further survey is needed for the purpose of making estimates.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. HENRY N. BABCOCK, ASSISTANT ENGINEER.

ENGINEER OFFICE, U. S. ARMY,
New York City, October 8, 1888.

COLONEL: I have the honor to submit the following report upon a preliminary examination of Mystic River, Connecticut, made September 15, 1888, in compliance with your letter of instructions dated August 30, 1888.

GENERAL DESCRIPTION.

Mystic River is a narrow tidal stream in the eastern part of the State of Connecticut, about 7 miles west from the boundary of the State of Rhode Island. The navigable part of the river extends in a general north-northeasterly direction for nearly 4 miles from Fisher's Island Sound, past the villages of Noank, Mystic River, and Mystic

Bridge, above which places it receives the discharge of several small fresh-water streams, which extend a few miles farther northward. The villages of Mystic River and Mystic Bridge lie, respectively, on the west and east-banks of the river, opposite each other, and about 3 miles above Fisher's Island Sound; at this point the stream is crossed by a highway bridge, with draw. It is below this draw-bridge that improvement is desired. Nearly half a mile farther down is the draw-bridge of the New York, Providence, and Boston Railroad, and about $1\frac{1}{2}$ miles still farther is the village of Noank, on the west bank. The population of Mystic River and Mystic Bridge together is about 3,500, and that of Noank about 1,600.

With the exception of about half a mile, the channel up to Mystic Bridge has a depth of 15 feet or more at mean low water; its width of from 80 to 300 feet is sufficient; but there are several bends in its course which make it rather difficult of navigation. Directly opposite the mouth of the river lie Mystic or Ram Island and Ram Island Shoal, which cause the channel to divide and branch off sharply to the northeast and southwest. The northeast channel is 18 feet or more in depth and of sufficient width, but somewhat crooked; it is the one used by large vessels; the southwest channel opens into a broad flat with about 12 feet available depth.

The mean rise of tide is $2\frac{1}{2}$ feet.

Mystic River is in the New London collection district, of which New London is the port of entry. The nearest works of defense are Forts Trumbull and Griswold, in New London Harbor, about 6 miles west. There is a light-house on Morgan's Point, on the west side of the river at its mouth.

PRESENT COMMERCE.

The business interests of the villages bordering on Mystic River, which depend upon water transportation, are ship building and repairing, foundry and machine work, manufacturing woolen goods, quarrying riprap and silex, and distributing fuel and building materials over a district covering 15 square miles and containing 7,000 inhabitants.

In ship-building, the number of hands employed ranges from 50 to 300, varying from time to time with the amount of work in progress; there are six ship-yards along the river, only three of which are now open. Vessels of the largest size have been built in these yards—steamers, ships, barks, and several war vessels, including one or more iron-clads.

Riprap granite for Government work at Thames River, Stonington, and elsewhere has been quarried on Mason's Island, on the east side of the channel above Noank.

There is a large silex quarry about 7 miles north of Mystic Bridge, in which \$100,000 has been invested within the past year; this includes purchase of property and building a store-house for shipping facilities at Mystic Bridge. It is represented that this silex is unexcelled for pottery manufacture, and that it possesses the advantage of pulverizing readily.

In the summer time there are two lines of passenger steamers making daily excursions to and from this harbor.

During the past year a record has been kept of 769 vessels entering the harbor, of draught generally 8 or 9 feet, and in one or two cases as great as 13 or 15 feet; the deep draught vessels generally bring coal for local use, or yellow pine for the ship-yards. These vessels carried 50,000 tons of freight and merchandise, valued at about \$400,000.

The accompanying reports from residents of the locality give further details of the commerce.

PROSPECTIVE COMMERCE.

The villages along this river form a thriving community in which, during the past year, \$133,000 has been expended on a system of water-works, a considerable amount in developing the silex quarries, and about \$50,000 on a woolen mill; a factory for making seines is about to be started. It is not claimed that the prospective commerce will show any extraordinary gain, but only such increase as will naturally follow from the growth of the community and the development of its business and its natural resources.

DESIRED IMPROVEMENT AND ESTIMATE.

What is especially desired here is the cutting off of five bends in the stream, and deepening the channel so as to make 15 feet at mean low-water up to the highway bridge. The removal of Katuis Rocks and of the Ballast Rocks was also suggested as desirable.

The amount of dredging required at the several points may be roughly estimated as follows:

	Cubic yards.
Highway bridge to railroad bridge, 2,300 feet; deepening channel part of the distance	4,000
Railroad bridge to Oldfield ship-yard, 2,600 feet; deepening channel and reducing bend in upper 1,000 feet	35,000
Reducing bend just below Pine Hill Wharf	21,000
Reducing two bends at either end of the reach south of Sixpenny Island and just above Noank, or cutting a channel 100 feet wide through the lower bend, which would serve the same purpose with about the same amount of work	60,000
Reducing the bend at the mouth of the harbor, between the harbor channel and the northeast channel	40,000
Total	160,000

Katuis Rocks appear to be a cluster of boulders, some of them of large size, lying in about 7 feet of water, on the west side of the channel half-way between Mystic Bridge and Noank. To remove these to the depth of the surrounding bottom would cost, at a very rough estimate, \$3,000; it would only serve to widen the channel for light-draught vessels at a point where it is already 200 feet wide or over, and it would seem that if the rocks were properly marked they could be easily avoided.

The Ballast Rocks lie on the east side of the channel, nearly half a mile below Katuis Rocks; they consist of stones, probably all of small size, extending at intervals along about 400 feet. As in the case of Katuis Rocks, buoying them properly is all that is really needed; it is probable that they could be taken out by a dredge at a cost of \$500.

Dredged material could be dumped on the flats southwest of and close to Mason's Island without danger of washing back into the channel; if any private interests would be injured by dumping there it could be done in over 7 fathoms of water in Fisher's Island Sound, at an average distance of less than 3 miles from the work.

The material to be dredged would be chiefly soft sand and mud, and the whole work outlined above would cost, at 16 cents per cubic yard, measured in scoops:

160,000 cubic yards, at 16 cents	\$25,600
Supervision and contingencies, say	4,400
Total	30,000

To maintain these channels it is estimated that an average annual expenditure of about \$2,000 would be required.

The above estimates are based upon a tracing of Coast Survey soundings taken in 1882.

Respectfully submitted.

HENRY N. BABCOCK.

Col. D. C. HOUSTON,
Corps of Engineers, U. S. A.

STATEMENT OF INDUSTRIES AND TRAFFIC FOR 1887 OF MYSTIC RIVER, CONNECTICUT.

[Compiled by Mr. George A. Slack, secretary Mystic Valley Board of Trade.]

The prosperity of the villages of Noank, Mystic River, Mystic Bridge, Upper Mystic, and two other small factory villages, covering an area of about 15 square miles, with a population of 7,000, depends mostly on the navigable condition of the Mystic River.

The industries of these villages are:

One large and 2 smaller ship-yards, in full operation; a spar-yard, a foundry, 2 machine-shops, 2 grist-mills, 2 woolen-mills, 2 stone-quarries, siliceous works (connected with one of the largest and best deposits of siliceous in this country), and about 10 other small manufacturing industries.

The traffic is as follows for 1887:

Cargoes.	Vessels.	
	Draught.	Tonnage.
	<i>Feet</i>	
Eighty-five cargoes of quarried stone, 27,000 tons; all is freighted by three barges	9	300
Eight cargoes of paving-stone	9	300
Eight cargoes of silex	8	300
Four cargoes of ship-timber	8	2-0
Two cargoes of piles	8	300
(Several cargoes of wood, and also a number of trading vessels, of which no record is kept of draught, tonnage, or number of trips.)		
Forty-one cargoes of coal, gross tonnage, 13,500	8	300

Three cargoes of pig-iron, gross tonnage, 600; 1 cargo of molding sand, 4 cargoes of lumber, 8 feet draught; 3 cargoes of brick, 7½ feet draught; 5 fishing steamers, 9 feet draught, and 15 other vessels engaged in coast trade and fishing.

There have been 146 cargoes received and shipped from the wharves on this river, with a recorded tonnage of about 50,000. This has required the towing of 120 cargoes by tugs, 8 feet draught.

Two passenger steamers of 7½ feet draught have made 230 round trips.

Other special boats, fishing steamers, and fishing boats, making 260 trips; making a total of 769 crafts of which there is a record kept.

No appropriations have ever been made for the improvement of this river.

SUMMARY OF THE SHIP-BUILDING INTERESTS ON THE MYSTIC RIVER, IN THE TOWNS OF STONINGTON AND GROTON, STATE OF CONNECTICUT.

There are six ship-yards on the river, from which many large steamers, ships, barks, brigs, and schooners have been built, besides a number of smaller yards, where small steam and sail yachts and other small craft are built.

Most of these large yards are now suspended on account of the depression in the commercial and ship-building interest of our country; but in the palmy days of the shipping interest of the country these yards were swarming with men and materials.

In the ship-yard of George Grinnam & Brothers, from about 1840, there were built 21 steamers, 13 ships, 5 barks, 6 brigs and schooners, besides a number of smaller craft. The amount of the tonnage of these vessels we have no data for.

In the ship-yard of Charles Mallory, esq., there were built since 1851 42 steamers, of 23,955 tons; 12 clipper ships, mostly for the California trade, of 12,365 tons; 6 barks and schooners, of 3,494 tons; besides a number of craft, barks, and schooners, having been built by Capt. Peter Foreyth in this yard previous to its being occupied by Mr. Mallory.

In the ship-yard of Irons & Grinness there were built, from about 1840 to 1858 (the death of Mr. Irons), 8 ships, of about 7,300 tons; 12 brigs and schooners, of about 2,800 tons; and by Hill & Grinness, in the same yard, after the close of the war (they having been engaged in Government employ during the war), 16 steamers, barks, and schooners, of about 2,882 tons; and by M. C. Hill, after the retirement of Mr. Grinness, 8 steamers, of about 1,200 tons, besides smaller craft.

These yards are all on the east bank of the river in the town of Stonington. On the west bank of the river in the town of Groton is the ship-yard of John A. Foreyth, where were built several vessels, ships, schooners, and yachts, the data of which I am unable to procure on so short notice.

In the ship-yard of Maxon, Fish & Co., and their successors, there have been built a large number of steamers, ships, barks, brigs, and schooners, besides barges and other craft, probably in all from 30 to 40; but the exact number of which I am unable to state; some war vessels were built in this yard and one iron-clad vessel. Also in the ship-yard of John and Robert Palmer, and Robert Palmer & Sons, which is now in active operation, there have been a large number of large steamers, ships, barks, brigs, and schooners built, besides many other craft of various kinds, the data of which I am unable to give, but I am just informed that Mr. Palmer will give by letter himself.† " " " And right here I would say that during the late war all of

† I have been promised a copy of this letter, but have not yet received it.

these yards, with the exception of two (and the proprietors of these were in the employment of the Government), were actively engaged in building war vessels and transports for Government use, and since the war there have been built in the three first yards named 15 steam gun-boats for the Spanish Government.

As our commerce increased the demand for larger and still larger vessels it became a very embarrassing subject how we could overcome the disadvantages of our crooked and shallow channel, and to this, doubtless, with other causes, may we attribute the loss of our commercial and building interest.

During the days when the whaling interest was prosperous there was a large number of whale-ships that sailed from this place (somewhere from fifteen to twenty or more ships), and they were very much embarrassed, and suffered much loss on account of the bars in the river and the crookedness of the channel, and I think, if I am not mistaken, they obtained some assistance from the State through the charter of a bank.

Respectfully submitted.

M. C. HILL.

MYSTIC BRIDGE, *January 31, 1888.*

D 26.

PRELIMINARY EXAMINATION OF PORT JEFFERSON INLET, NEW YORK.

ENGINEER OFFICE, U. S. ARMY,
New York, December 5, 1888.

SIR: I have the honor to submit the following report of a preliminary examination of Port Jefferson Inlet, Long Island, N. Y., made in pursuance of the river and harbor act of August 11, 1888, and directed in letter from the Chief of Engineers, dated August 28, 1888.

An examination of the harbor was made in October, 1888, by Mr. Henry N. Babcock, assistant engineer, who has collected the necessary information in reference to the harbor.

GENERAL DESCRIPTION.

Port Jefferson Harbor is on the north shore of Long Island and about 50 miles east from New York City. It is a mile long and averages three-quarters of a mile wide, and a large part of the area has depths of 18 feet or more at low tide. Tributary to this harbor on the west are Setauket Harbor and Conscience Bay, two shallow tidal basins. Port Jefferson Harbor is surrounded on three sides by hills and is separated from Long Island Sound on the north by a beach of sand and gravel through which, and nearly in the axis of the harbor, is a single entrance 400 feet wide; this entrance is *Port Jefferson Inlet*, and through it a tidal reservoir of 2 square miles area receives and discharges some 300,000,000 cubic feet of water with every tide, producing a current whose maximum velocity is over 4 miles per hour. In the narrow part of the inlet the depth has always been considerable, but a short distance out into the Sound was a bar which originally had a depth of 4 feet at mean low water. Until the beginning of Government improvement the location of the inlet had been shifting; from 1838 to 1871 it had moved westward 790 feet, an average annual rate of 24 feet. The village of Port Jefferson, with a population of about 3,000, lies at the head or south end of the harbor. The mean rise of tide at the village wharves is 6.2 feet, in Long Island Sound outside the inlet it is 7 feet; the difference is altogether in the low-water levels.

Port Jefferson is a port of delivery in the collection district of New York. The nearest light-house is on Oldfield Point, a mile and a half west of the inlet.

PREVIOUS IMPROVEMENTS BY THE UNITED STATES.

A survey of the harbor was made in 1853 by Lieutenant Harrison, U. S. Engineers. In 1870 an examination of the harbor was ordered by Congress, and in 1871, after the examination, a project for improvement was submitted by General G. K. Warren, Corps of Engineers (see Annual Report of the Chief of Engineers for 1871, page 805), which provided for building a breakwater or jetty on the east side of the inlet to extend to the 9-foot curve, and for dredging a channel 200 feet wide and 7 feet deep at mean low water.

Under this project, with modifications made in 1875 and 1877, the east jetty was built 1,390 feet long, terminating in 10 feet depth, and rising to 5 feet above high water, with triangular cross-section and side slopes of one upon one; a west jetty of similar cross-section was built 940 feet long, terminating in $6\frac{1}{2}$ feet depth, the inner part of which was made 4 feet above high water and the outer part (450 feet) 2 feet above low water, except a point at the outer end and one intermediate point, which were made 4 feet above high water, to mark the location of the jetty; a channel was also dredged 100 feet wide and 8 feet deep. The last work done was in 1883.

PRESENT CONDITION OF CHANNEL AND JETTIES.

The east jetty, for about 100 feet at its outer end, has settled or been undermined so that it stands at or below high water; thence into high-water mark on the beach it averages about 2 feet above high-water level with about 5 feet top width.

The peaks in the outer half of the west jetty, which were built 4 feet above high water, now stand at about high-water level; the low part does not seem to have settled materially; the part at the shore end, which was built to 4 feet above high water, has settled about 2 feet; the top width of this jetty would average 4 feet.

Both the jetties are in rough, irregular condition, so that their average width and height can only be estimated approximately.

The channel dredged in 1880 retains its depth of 8 feet, but the width, originally made 100 feet, is now about 75 feet.

A wooden fence built at the shore end of the east breakwater to catch drifting sand is now nearly covered.

The published Coast Survey chart of 1888 (hydrography in 1886) represents the depths in and outside the inlet practically as they now exist.

DESIRED IMPROVEMENTS AND ESTIMATES OF COST.

The improvement which it is desired to secure in this harbor is the making of a channel through the inlet of 200 feet width and, if practicable, of 12 feet depth at mean low water, with such enlargement and extension of the jetties as may be necessary to preserve the channel; and particularly to have the low part of the west jetty raised above high water level; it is said that small vessels have been injured by trying to enter the harbor across this submerged jetty, supposing it to be an open passage.

Such a channel would involve dredging for a length of 2,200 feet where the present depth ranges from $3\frac{1}{2}$ to 12 feet, and where the bottom is for the most part a very compact bed of sand, gravel, and stones. The channel would then extend about 200 feet beyond the east jetty, and it would be desirable and probably necessary to extend the jetty, say 250

feet, to make the channel permanent. The west jetty would not require extension.

The jetties were built on about a triangular cross-section, with little top width, and with side slopes of one upon one; the tops have fallen down, reducing the height and increasing the width. This is too small a cross-section for permanent work; the position of the east jetty is about as exposed as any on Long Island Sound, and its cross-section should not be much less than that adopted for the New Haven Breakwater, say 10 feet top width, rising to 6 feet above high water, with outer or east slope of one on two and inner slope of one on one. The west jetty is partly sheltered, the east jetty protecting it on one side and Oldfield Point partly covering its exposure to the west; it would perhaps be sufficient to make it 4 feet above high water, with 6 feet top width and with both slopes one upon one. On the east jetty it is proposed to carry the enlarged cross-section from the outer end into high-water mark, 950 feet; on the west jetty, to a point 600 feet in from the outer end; the parks further inshore are protected to some extent by shoal water and by the sand which has banked up against them; they need slight repairs.

The cost of the work above indicated would be approximately as follows:

Enlarging east jetty, to make it 6 feet above high water, with 10-foot top width, outer slope of one-half and inner slope one on one for 950 feet length at outer end; 20,000 tons riprap, at \$1.65.....	\$33,000
Repairing east jetty, inshore from high-water mark; about 500 tons riprap, at \$2.40.....	1,200
Enlarging west jetty, for the outer 600 feet, to make it 4 feet above high water, with top width of 6 feet and side slopes of one on one; 9,000 tons riprap, at \$1.75.....	15,750
Repairing west jetty, inshore from proposed enlargement; about 1,000 tons of riprap, at \$2.40.....	2,400
Extending east jetty, for 250 feet to 21 feet depth of water, with same dimensions as proposed enlargement of that jetty; 22,000 tons of riprap, at \$1.60.....	35,200
Dredging, outside the narrow part of the inlet, to make a channel 12 feet deep and 200 feet wide, being about 2,200 feet long; 90,000 cubic yards, at 45 cents.....	40,500
Dredging inside inlet, to make a straight channel of the same depth and width, and about 1,300 feet extreme length; 16,000 cubic yards, at 16 cents.....	2,560
Dredging outside narrow part of inlet if the channel be made only 19 feet deep, 200 feet wide, and 2,100 feet long; 55,000 cubic yards, at 45 cents.....	24,750
Dredging inside inlet for 10 feet depth; 4,000 cubic yards, at 16 cents.....	640

The 10-foot channel would probably not require an extension of the east jetty, but any estimate should include repairing and enlarging both jetties; this could be done sufficiently for present purposes at about one-half the estimated cost, but further and extensive enlargement would probably be needed in a few years. The estimates above given are believed to cover what is required to put the jetties in permanent condition, after which but slight repairs from time to time would be needed, though in any case it may be necessary to further extend the east jetty in course of time.

SUMMARY OF COST.

For channel 12 feet deep and 200 feet wide:	
Repairing and enlarging east jetty.....	\$34,200
Repairing and enlarging west jetty.....	18,150
Extending east jetty.....	35,200
Dredging.....	43,060
Contingencies, say.....	14,390
Total.....	145,000

For channel 10 feet deep and 200 feet wide:

Repairing and enlarging east jetty	\$34,300
Repairing and enlarging west jetty	18,150
Dredging	25,300
Contingencies, say	12,200
Total	90,000

GENERAL SUMMARY.

The work done by the United States in this harbor from 1872 to 1883 resulted in fixing the previously shifting channel and increasing the depth from 4 to 8 feet at mean low water, at a cost of \$80,000. In the latter year, 1883, the amount estimated for completion had been expended upon the work and, though it was considered and stated in annual reports for that and subsequent years that it was by no means certain that the improvement as then made would be permanent, no further appropriation was asked for at the time; because it was believed that a short delay would result in no serious injury to the works and would better indicate what would be needed to make the improvements permanent.

The object for which the present examination was desired was to secure the jetties permanently and to increase the channel width and depth. The width desired is 200 feet; at first it was proposed to ask that the depth be made 12 feet at mean low water, but subsequently 10 feet depth was decided upon, as being sufficient for present needs. The estimated cost of this work is \$90,000, of which about two-thirds would be required for placing the jetties in permanent condition, and the remaining third for dredging the channel 200 feet wide and 10 feet deep.

Commercial statistics for the calendar year of 1886 show 1,342 arrivals and departures of vessels, aggregating 141,970 tons registered tonnage, and receipts and shipments by water of 26,495 tons of freight, chiefly fuel, building materials, farm produce, and general merchandise of value estimated at \$423,000.

Port Jefferson Harbor is the winter quarters for several yachts; it is the only harbor on the south side of Long Island Sound east of Huntington, and is sometimes sought as a harbor of refuge; it is represented that the latter use would be much increased if the entrance were made easy at all stages of the tide.

I am of opinion that this harbor is worthy of improvement. The work proposed is necessary to perfect the improvements already made.

The accompanying sketch from the United States Coast Survey chart of 1888, scale 1-10,000, shows the location of the desired improvement. This and the maps of examinations made in connection with the previous improvements are sufficient for developing a plan for new improvement, with a reasonably close estimate of cost, and no further survey is needed for that purpose.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

APPENDIX E.

IMPROVEMENT OF HUDSON RIVER AND OF HARBORS OF RONDOUT AND SAUGERTIES, NEW YORK—REMOVING OBSTRUCTIONS IN EAST RIVER AND HELL GATE—IMPROVEMENT OF ENTRANCE TO NEW YORK HARBOR—IMPROVEMENT OF RIVERS AND HARBORS IN THE VICINITY OF NEW YORK AND IN NORTHERN NEW JERSEY.

REPORT OF LIEUTENANT-COLONEL G. L. GILLESPIE, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1889, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

- | | |
|--|--|
| 1. Hudson River, New York. | 7. Buttermilk Channel, New York. |
| 2. Harbor of Saugerties, New York. | 8. Gowanus Bay, New York. |
| 3. Harbor of Rondout, New York. | 9. New York Harbor. |
| 4. Harlem River, New York. | 10. Raritan Bay, New Jersey. |
| 5. Removing obstructions in the East River and at Hell Gate, New York. | 11. Removing sunken vessels or crafts obstructing or endangering navigation. |
| 6. Newtown Creek, New York. | |

EXAMINATIONS AND SURVEYS.

- | | |
|---------------------------------|--|
| 12. Tarrytown Harbor, New York. | 13. For a ship-channel between Jersey City and Ellis Island. |
|---------------------------------|--|

HARBOR LINES.

14. Establishment of harbor lines of New York Harbor and its adjacent waters.
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ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., July 12, 1889.

GENERAL: I have the honor to transmit herewith annual reports for the fiscal year ending June 30, 1889, upon the works of river and harbor improvements under my charge.

Lieut. Col. Walter McFarland, Corps of Engineers, U. S. Army, in charge of these improvements at the close of the last fiscal year, died July 22, 1888. He was succeeded by Capt. Geo. McC. Derby, Corps of Engineers, U. S. Army, who remained in temporary charge till January 2, 1889, at which time he was relieved by me in compliance with Special Orders No. 269, Headquarters of the Army, Adjutant-General's Office, Washington, D. C., November 17, 1888.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

E 1.

IMPROVEMENT OF HUDSON RIVER, NEW YORK.

The Annual Report for 1885 contained a history of this improvement, accompanied by original reports and two sketches showing its condition at that time. This may be found in the Annual Report of the Chief of Engineers for 1885, part 1, page 677.

The only part of the Hudson River which has been improved by the General Government is the stretch about 20 miles long beginning at the head of navigation at Troy, N. Y., about 6 miles above Albany, and extending down the river to New Baltimore, about 14 miles below Albany.

While there has always been enough water below New Baltimore for navigation, this upper section of the river, so far as its history is known to us, has always been obstructed by bars and shoals due to the existence of numerous islands and sloughs, and the consequent diversion of the river's waters through too many channels.

Prior to 1831, when the jurisdiction of the Federal Government over these waters was confirmed by judicial decision, the State of New York had made efforts to improve the navigation of this part of the river.

Since 1831, the improvement of the Hudson River has been conducted both by the State of New York and by the General Government, both building and repairing dikes and doing such dredging as seemed necessary. In the last few years, however, the dike work has been left almost exclusively to the General Government, while the State of New York has done most of the dredging required.

The general system of improvement has been the same throughout, viz, the contraction of the channels by the construction of jetties and dikes intended to deepen them by means of the scour so produced, and also deepening by dredging where it could not be dispensed with.

But up to 1831 the work, which had consisted almost entirely of the construction of spur-dikes and of dredging, had produced very little permanent improvement.

After 1831, however, the United States began the present general system of improvement, which consists of contracting the channel by means of longitudinal dikes intended to aid in scouring the bars and shoals instead of using spur-jetties, as had been done previously.

Under this system the United States constructed two dikes in 1835, 1836, 1837, and 1838.

Then followed a long interval of time in which nothing was done by the United States, except in 1852; but in 1863 the State of New York took up the improvement on the general plan adopted by the United States in 1831, viz, substituting a system of longitudinal dikes instead of the jetty system, and between 1863 and 1867 built six important longitudinal dikes of this kind. (Annual Report of 1885, page 678.)

The work was taken up again by the United States in 1864, when, out of the general sum appropriated for river and harbor improvement, \$33,000 was allotted for the Hudson River Improvement, and this was followed by the act of June 23, 1866, which appropriated \$50,000 for the same work.

The plans under which the present works of improvement of the river are conducted were adopted in 1866, and provided for securing a navigable channel 11 feet deep at mean low water from New Balti-

more up to Albany, and 9 feet deep at mean low water from Albany up to Troy.

The following is a description of the plan :

First. A system of longitudinal dikes to confine the current sufficiently to allow the ebb and flow of the tidal current to keep the channel clear. These dikes to be gradually brought nearer together from New Baltimore towards Troy, so as to assist the entrance of the flood current and increase its height, their height to be kept approximately at the level of the tidal high water, so as not to confine the freshets ; the exact level, however, being left to be determined by experience as the work progresses.

Second. That the dredge be used so far as necessary to open the channels above described, which the current should not be allowed to do, except very gradually, lest accumulations dangerous to navigation be formed below.

Third. Keeping, as far as practicable, the side reservoirs open to the passage of tidal currents by gaps at their lower extremities, in order to increase the tidal flow.

Fourth. Dumping all dredged materials in secure places, where it can not be moved back into the channel by the current.

Fifth. Constructing the dikes of timber and stone, in a manner to secure their permanency, at a minimum cost, the details varying with the locality, to be left to the discretion of the local engineer, to be so designed as to admit of having an increased height given to the dikes if necessary.

Sixth. To protect, when necessary, the banks and islands against the abrading action of the current by revetments.

Seventh. That limits, beyond which no encroachments upon the channel should be made, be prescribed, and that any such encroachments be reported to the engineer in charge.

The estimated cost of this improvement was \$862,297.75 ; this estimate was increased several times at later periods to take account of expenditures for repairs and for work done not included in previous estimates, and was given in 1882 as \$1,078,304.47. The last revised estimate is given in the Annual Report for 1888, where it is stated that \$260,000 will be required for the repair and completion of the works of the Upper Hudson, over and above the amounts appropriated, which at that time amounted to \$1,054,330.57.

After timber has been exposed for eight or ten years, it decays very rapidly, and the structures formed by it are liable to serious injury from slight causes ; whether ice, freshets, or collisions. It is not surprising, therefore, that the cost for repairs increases annually, and that the appropriations of the past few years, which were small relatively, had to be applied chiefly to strengthening old work. During the past winter and spring the dikes have been carefully examined by Mr. R. H. Talcott, assistant engineer, at low and high stages of water, and it was found that the estimate for repairs contained in the last Annual Report did not nearly cover all the expenditures that were required to be made to preserve the dikes and to render them serviceable in maintaining the channel depths. The examination was made with special reference to the future application of the appropriation of \$75,000, of act of August 11, 1888. The pile-dikes existing on both banks, from New Baltimore to Albany, were observed to be in a very bad condition. In many places the original structure had been carried away, excepting the stone filling, which had been leveled off to a gentle slope, and generally the timber-work of the structures which remained standing needed large expendi-

tures both for timber and stone. The estimate of Mr. Talcott is as follows:

ESTIMATED COST OF REPAIRING AND RESTORING DIKES IN THE HUDSON RIVER.

	Stone.	Amount.		Stone.	Amount.
	<i>Obv. yds.</i>	<i>Dollars.</i>		<i>Obv. yds.</i>	<i>Dollars.</i>
West Dike	5,000	7,500	Barren Island to Overlaugh		
Mull's Island Dike	3,000	4,500	Dike No. 1	400	1,000
Coeymans Middle Ground			Overlaugh Dike No. 1	300	3,700
Dike	700	1,050	Bogart's Island Dike	1,500	2,750
Barren Island Dike	2,400	3,350	Small Island Dike	5,000	11,000
Coeymans Dike	100	100	Papacannee Dike, section I ..	4,000	11,500
Roah Hook Dike	350	525	Douro's Point Dike, extension south	2,200	5,300
Mull's Dike	25,000	37,500	Douro's Point Dike	800	1,000
Shad Island Dike	400	800			
Schodack Island Dike	200	200	Total from New Baltimore to Albany	101,640	187,855
Nine Mile Tree Dike	20	50			
Castleton Dike, extension north	800	1,000	Bath Dike	1,100	2,300
Cedar Hill Dike	4,000	12,000	Base Island pile-dike	650	1,950
Cow Island, single pile-dike ..	5,000	10,000	Base Island crib-dike	4,000	14,000
Cow Island Dike	100	80	Patroon's Lower Island, single pile-dike	3,000	10,500
Campbell's Island Dike	20	50	Patroon's Lower Island, crib-dike	2,000	7,000
Campbell's Island, single pile-dike	400	1,000	High Dike	2,500	8,000
Cedar Hill, single pile-dike ..	500	800	Port Schuyler Dike	400	3,500
Winnies Dike	800	3,200			
Bear Island Dike	4,000	5,000	Total Albany to Troy ..	13,650	47,250
Staats single pile-dike	25,000	35,000	Total New Baltimore to Albany	101,640	187,855
Stone Light Dike	1,000	3,000			
Papacannee Dike, section III ..	3,500	8,750	Grand total	115,290	235,105
Papacannee Dike, section II ..	3,000	7,500			
Overlaugh Dike No. 2	600	4,000			
Abbey Channel Dike	600	1,500			
Beacon Island, half-dike	150	150			

As the amount made available for repairs by the act of August 11, 1888, increased by balance from former appropriations, was \$95,064.25 only, the project submitted to the Chief of Engineers June 22, 1889, for the application of this sum, recommended that the repairs be limited to the dikes enumerated below, whose particularly impaired condition demanded immediate attention, viz:

	Stone.	Amount.		Stone.	Amount.
	<i>Obv. yds.</i>	<i>Dollars.</i>		<i>Obv. yds.</i>	<i>Dollars.</i>
Coeymans:			Papacannee Dike:		
Barren Island Dike	2,400	3,350	Section I	4,000	11,500
Roah Hook Dike	350	525	Overlaugh:		
Mull's:			Albany Channel Dike ..	600	1,500
Mull's Dike	15,000	22,500	Bogart's Island Dike ..	1,500	3,750
Shad Island Dike	400	450	Small Island Dike	1,200	1,000
Cedar Hill:			Douro's Point Dike, extension south ..	1,100	2,750
Cedar Hill Dike	4,000	12,000	Douro's Point Dike	800	1,000
Cedar Hill, single-pile dike		50	Round and Fish-house Shoals:		
Winnies Bar:			Bath Dike	1,100	2,300
Winnies Dike	800	3,200	Base Island, pile-dike ..	650	1,950
Overlaugh:			High Dike	2,500	8,000
Stone Light Dike	1,000	3,000	Port Schuyler Dike	400	3,500
Papacannee Dike:					
Section III	1,000	2,500	Total cost of repairs ..	40,250	87,775
Section II	850	1,750			

These repairs will be made by contract after inviting sealed proposals by public advertisement. From the nature of the materials which entered into the construction of the dikes, and from the limited sums which can be applied annually to renew the parts which become unserviceable, whether by natural decay or otherwise, it must be understood that he estimates prepared from time to time for the completion

of the project can be accepted as approximately accurate for only a short period of time. This statement seems necessary for a correct understanding of the apparent discrepancy between the estimated cost of the project, and the sums which have been appropriated for its execution.

The permanent works remaining to be built in order to complete the improvement as originally projected are:

1. Completion of dike from Staat's Island to Campbell's Island Dike.
2. Completion of dike from Schermerhorn to Shad Island,
3. The proposed improvement below Shad Island and Mull's Plaet.
4. The improvement at Willow Island.
5. The construction of a new dike below Nine Mile Tree.
6. The extension of the dike at Mull's Plaet.
7. The removal of the Overslaugh Rock at Van Wie's Point.

The first six of these items were estimated in 1882, to cost \$78,000; and the seventh item, under estimate of 1884, was to cost \$16,000, making the total amount needed for completing the original project \$94,000.

Owing to the damages which the Staats Island Dike has sustained since the estimate of 1884 was made, it is probable that the estimate for the new work yet to be done to complete the project, which is given in the Annual Report for 1888, should be increased to \$135,000. The revised estimate of cost on this basis, therefore, for the construction of the new works, and for the repair of the old ones, is \$370,105, increasing the estimate for work from the beginning to \$1,424,435.

The State of New York makes an appropriation at every session of its legislature for the improvement of the Hudson River, and prior to 1867 the money was applied to the construction of dikes on the left bank of the river from Hotaling Island to Albany, to jetties, dams, and to temporary measures of relief, and also to dredging at the points where shoals were discovered after the spring freshets. In the last few years, however, the dike work has been left almost exclusively to the General Government, while the State has done the most of the dredging required. The manner in which the dredged material is disposed of by authority of the State is very objectionable. Instead of being carried directly to a secluded dumping-ground remote from the action of the currents of the river, where its deposits will be beneficial in strengthening the dikes and cross-jetties, it is frequently deposited directly into the channel, along the face of the dikes or upon the dikes, where it is readily washed back into the channel. As this method has a tendency to produce shoals at points where deep water previously existed, it would seem that the General Government should interpose and prohibit by stringent legislation the continuance of operations by the State whose effect is ultimately to obstruct navigation.

The commerce of this river is exceedingly large, and has an estimated annual valuation exceeding \$250,000,000. An instructive review of the commerce of the river and the part which the improvement of the river has played in reducing the cost of transportation and the rates of insurance, are given in pages 657-660 Annual Report Chief of Engineers, 1887.

AMOUNTS APPROPRIATED.

By act of Congress approved—

June 30, 1834.....	\$70,000.00
July 2, 1836.....	100,000.00
March 3, 1837.....	100,000.00
July 7, 1838.....	100,000.00
August 30, 1852.....	50,000.00
	<hr/>
	420,000.00

AMOUNTS APPROPRIATED FOR PRESENT PROJECT.

By act of Congress approved—

June 28, 1864, allotment	\$33,000.00
June 23, 1866	50,000.00
March 3, 1867	305,188.00
July 25, 1868	85,000.00
April 10, 1869	89,100.00
July 11, 1870	40,000.00
March 3, 1871	40,000.00
June 10, 1872	40,000.00
March 3, 1873	40,000.00
June 23, 1874	40,000.00
March 3, 1875	40,000.00
August 14, 1876	50,000.00
June 18, 1878	70,000.00
March 3, 1879	30,000.00
June 14, 1880	20,000.00
March 3, 1881	15,000.00
By act of Congress passed August 2, 1882	10,000.00
By act of Congress approved July 5, 1884	30,000.00
August 5, 1886	26,250.00
August 11, 1888	75,000.00

1,128,528.00

Received from other sources..... 792.57

1,129,320.57

Amount expended to June 30, 1889, inclusive of outstanding liabilities..1,033,739.59

This work is in the collection district of New York, Albany being a port of entry.

Money statement.

July 1, 1888, amount available	\$21,458.28
Amount appropriated by act of August 11, 1888	75,000.00
	96,458.28

July 1, 1889, amount expended during fiscal year exclusive of liabilities outstanding July 1, 1888	\$1,394.00
July 1, 1889, outstanding liabilities	208.00
	1,602.00

July 1, 1889, balance available	94,856.28
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{ Amount (estimated) required for completion of existing project	235,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	200,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Statement of the number and tonnage of all vessels belonging to the port of Albany, N. Y., June 30, 1889.

[From A. D. Cole, esq., surveyor of port.]

	Number.	Tonnage.		Number.	Tonnage.
Steam-vessels	194	81,849.06	Barges	74	14,780.58
Sailing vessels	45	2,655.69	Canal-boats	173	17,004.79

COMMERCIAL STATISTICS OF THE PORT OF ALBANY, NEW YORK, FOR THE FISCAL YEAR ENDING JUNE 30, 1889.

Value of imports	\$865,624.00
Duties collected thereon	152,561.48

Statement of the number of canal-boats arriving at tide-water of the Hudson River from the canals of the State, and leaving the Hudson for the canals, for the fiscal year ending June 30, 1889.

[From Hon. John Shanahan, superintendent public works, State of New York.]

Number of canal-boats arriving at high-tide water	15,795
Registered tonnage of same, aggregate	3,790,800
Number of canal-boats leaving tide-water	14,473
Registered tonnage of same, aggregate	3,473,520
Amount of freight or merchandise arriving at tide-water, for year ending June 30, 1889	3,158,923
Value of same	\$94,767,690
Amount of freight or merchandise leaving tide-water for the canals for the year ending June 30, 1889	1,447,392
Value of same	43,421,760

E 2.

IMPROVEMENT OF SAUGERTIES HARBOR, NEW YORK.

The harbor of Saugerties is the name applied to the mouth of Esopus Creek, which empties into the Hudson River, on the west shore, about 100 miles above the city of New York. With the exception of some slight works undertaken by the inhabitants, giving no permanent results, nothing had been done toward the improvement of this harbor until it was undertaken by the United States Government in 1887. In 1883 a survey of the harbor was made under the direction of the engineer officer in charge. Two plans of improvement were recommended, both providing for the construction of parallel dikes, and for dredging the channel between them. (See Annual Report of the Chief of Engineers for 1884, part I, page 716.)

A re-examination of the harbor, made in 1887, after the State had done some dredging in the channel, resulted in the submission of a third project, differing but slightly from those previously submitted, the main difference being in the location.

The project was approved, and its execution was begun the same year.

Its estimated cost was as follows:

North dike, 2,300 feet long:	
Pile work, 2,160 running feet, at \$7 per foot	\$15,120
Crib work, 140 running feet, at \$30 per foot	4,200
South dike, 2,300 feet long:	
Pile work, 2,200 running feet, at \$7 per foot	15,400
Crib work, 100 running feet, at \$30 per foot	3,000
Dredging, 30,000 cubic yards, at 25 cents	7,500
Contingencies about 15 per cent	6,780
Total	52,000

As the \$20,000 which had been appropriated for this improvement in 1884 and 1886 were only sufficient to build one of the proposed dikes, it was decided to apply it to the south dike only, leaving the other to be provided for by subsequent appropriations.

The construction of the south dike was begun under contract with Henry Du Bois's Sons July 28, 1887, and completed on June 25, 1888. The amount available July 1, 1888, was \$2,698.69.

By act of August 11, 1888, the sum of \$12,000 was appropriated for continuing the improvement.

A project for the expenditure of the appropriation was submitted February 12, 1889, and sealed proposals for dredging a channel 150 feet wide and 9 feet deep, mean low water, across the bar at the entrance and at different points on the inside, after due advertisement, were opened April 17, and a contract was made May 13 with Mr. Peter W. Myers, the lowest bidder, for the removal of 30,000 cubic yards of material at 15½ cents per cubic yard, scow measurement; 25,000 cubic yards to be taken from the shoal on north side of channel between Maxwell's and Freligh's wharves, and 5,000 from the bar. An additional project was submitted April 26, 1889, for applying the residue of the appropriation in beginning the construction of the north dike. Sealed proposals for this improvement were opened June 5, 1889, and the contract for building 125 feet of crib dike and 700 feet of pile-dike was awarded to Mr. William Parrott, the lowest bidder, at the rate of \$8.25 approximately per linear foot of dike.

Mr. Myers, the contractor for dredging, began his contract May 13, 1889, and the amount removed at the close of the fiscal year is 22,646 cubic yards.

The contractor for dike construction will begin work in July.

The amount required to complete the work in accordance with the approved plan is \$20,000, and if appropriated will be applied in completing the construction of the proposed dike on the north side, in making repairs to dikes, or in dredging shoals which may form between the dikes. A survey of the harbor from the entrance to the dam was made November 8, 1888, a distance of 1.7 miles.

The bar was then on a nearly straight line connecting the light-house and the outer end of the south dike, and the average distance between the 9-foot curves of the harbor and of the Hudson River was 1,000 feet approximately. The deep-water channel lay on the north side close to the light-house, and the least water on the bar was 7.3 feet, mean low water.

A statement of the ordinary commerce of Saugerties may be found in the annual report for 1887. In general it consists of bluestone, lumber, paper stock, and coal, aggregating annually 121,700 tons approximately, and has a valuation of \$4,837,500.

The range of tides is 4 feet, and the effect of the contemplated improvement will be to permit vessels of 12 to 14 feet draught to come directly to Saugerties with their cargoes, and to depart with full cargoes. The size of vessels will be increased and the rates of transportation will be lowered.

The commerce of the harbor is carried in 5 regular steam-boats for freight and passengers, 15 transient steamers, and 155 schooners, sloops, and barges.

Saugerties is in the collection district of Albany, N. Y., which is the nearest port of entry. The nearest light-house is at the mouth of Esopus Creek.

AMOUNTS APPROPRIATED.

July 5, 1884	\$5,000.00
August 5, 1886	15,000.00
August 11, 1888	12,000.00
Total	32,000.00

Amount expended upon the project up to the close of the fiscal year ending June 30, 1888	13,363.14
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Money statement.

July 1, 1888, amount available	\$2,698.69
Amount appropriated by act of August 11, 1888	12,000.00
	<hr/> 14,698.69
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$1,593.86
July 1, 1889, outstanding liabilities	2,528.21
July 1, 1889, amount covered by existing contracts	8,139.87
	<hr/> 12,261.94
July 1, 1889, balance available	<hr/> 2,436.75
<hr/>	
{ Amount (estimated) required for completion of existing project	20,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	20,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of bids for dredging in Saugerties Harbor, New York, opened at U. S. Engineer office, Army Building, New York, April 17, 1889, at 12 o'clock, under advertisement of March 9, 1889.

No.	Names of bidders.	Name and residence of sureties.	19,000 cubic yards.	
			Per cubic yard.	Amount.
1	Peter W. Myers	William Smith, Greenbush, N. Y.; James A. Smith, Greenbush, N. Y.	<i>Cents.</i> 15½	\$2,945.00
2	Michael H. Flannery	David J. Connel, Newport, N. Y.; James J. Carey, Newport, N. Y.	18	3,472.00
3	Edgar M. Payn	William Bruce, Albany, N. Y.; Dominick Fitzpatrick, Albany, N. Y.	38½	7,391.00
4	W. H. Van Patten	P. J. Brumilkamp, Syracuse, N. Y.; Charles E. Wiscwall, South Ballston, N. Y.	29½	5,605.00

Abstract of proposals for building a pile and crib dike at Saugerties Harbor, New York, received in response to the advertisement dated April 26, 1889, and opened June 5, 1889, by Lieut. Col. G. L. Gillespie, Corps of Engineers.

No.	Name of bidder.	Piles, 17,000 linear feet.		Round timber for crib, 4,000 linear feet.		Square timber, 23,200 feet B. M.	
		Per linear foot.	Amount.	Per linear foot.	Amount.	Per 1,000 feet B. M.	Amount.
1	William D. Fuller	<i>Cents.</i> 12	\$3,040.00	<i>Cents.</i> 10	\$400.00	\$42.00	\$974.00
2	L. Harbrecht & Co.	23	3,910.00	21	978.00	44.00	1,020.80
3	William Parrots	12	3,040.00	9	419.40	40.00	928.00
4	John A. Kelly	13	2,210.00	9	419.40	40.00	928.00
5	Fogg & Scribner	25	4,250.00	20	932.00	40.00	928.00
6	William A. Morton	20	3,400.00	14	652.40	40.00	928.00
7	John Gillies	30	5,100.00	10	400.00	44.00	1,020.80
8	P. Sanford Ross	18½	3,187.50	14½	675.70	45.00	1,044.00

Abstract of proposals for building a pile and crib dike, etc.—Continued.

No.	Name of bidder.	Tie-rods and screw-bolts, 3,400 pounds.		Drift-bolts and washers, 4,365 pounds.		Broken stone, 1,000 cubic yards.		Total amount bid.
		Per pound.	Amount.	Per pound.	Amount.	Per cubic yard.	Amount.	
		<i>Cents.</i>		<i>Cents.</i>				
1	William D. Fuller.....	6	\$204. 00	4½	\$207. 33	\$0. 98	\$980. 00	\$4, 871. 73
2	L. Harbrecht & Co.....	5	170. 00	4	174. 00	1. 95	1, 950. 00	8, 274. 00
*3	William Parrott.....	5	170. 00	4	174. 00	. 50	900. 00	4, 612. 00
4	John A. Kelly.....	4	136. 00	4	174. 00	1. 20	1, 200. 00	5, 068. 00
5	Fogg & Scribner.....	8	272. 00	6	261. 90	3. 25	3, 250. 00	9, 753. 90
6	William A. Morton.....	5	170. 00	3	130. 95	. 90	900. 00	6, 271. 35
7	John Gillies.....	10	340. 00	6	261. 90	1. 00	1, 000. 00	8, 188. 70
8	P. Sanford Ross.....	5	170. 00	5	218. 25	1. 15	1, 150. 00	6, 445. 45

* Lowest bid.

E 3.

IMPROVEMENT OF HARBOR AT RONDOUT, NEW YORK.

Rondout Harbor is formed by the mouth of Rondout Creek, which empties into the Hudson River, on its west side, about 90 miles above the city of New York.

From the entrance to the lock of the Delaware and Hudson Canal, a distance of 3 miles, the creek is a tidal stream, the range of tides being 4 feet, approximately.

Prior to 1871 improvements had been made by private persons and corporations, but no permanent benefit had been derived from them. In 1869 a survey of the harbor was made by the Government, with a view to its permanent improvement, and it was then found that the available depth of water in the channel was about 7 feet.

The project of improvement based upon this survey provided for the formation and maintenance of a channel 100 feet wide and 14 feet deep at the mouth of the creek, to be obtained by means of dredging and diking. Two parallel channel dikes were to be built outward, toward and into the Hudson River, their outer ends curving gently downstream, while a branch dike, running up-stream along the Hudson from the outer end of the north dike, was to protect that dike from destruction from running ice. The estimated cost of this work was as follows.

Building the north dike, 748 yards long	\$41, 600
Building the branch dike, 640 yards long	34, 400
Building the south dike, 1, 277 yards long	59, 600
Dredging a channel 3,000 feet long, 100 feet wide, and 14 feet deep at low water, 48,000 cubic yards, at 30 cents.....	14, 400
Contingencies	22, 500
Total.....	172, 500

The final length of the north and south dikes was, however, to be determined after observing the effects which they might produce in the removal of the bar as they were gradually extended onward. The work was begun in 1872, and was completed in 1880. It was found by experience that the dikes might be shortened so much below the lengths

originally deemed necessary for them that the total cost of the work was reduced to \$90,000, a little more than one-half the original estimate.

On the completion of the work, in 1880, the north dike was 2,200 feet, approximately, with a branch dike running up the Hudson 1,000 feet, approximately; and the south dike was 2,800 feet long, approximately, with a spur to the light-house 330 feet long. The distance between the dikes at the entrance was 350 feet, approximately. As the result of the works of improvement, there was a channel 50 feet wide, giving 13½ feet mean low water; 100 feet wide, giving 12 feet mean low water, and 200 feet wide, giving 10 feet mean low water, from the creek to the channel of the Hudson. At the outer end of the dikes the distance between the 12-foot curves was over 300 feet.

The north dike was originally built to the height of mean high water, while the south dike, for 500 feet west of light-house, was built only to level of half-tide. The low part of south dike was subsequently raised by crib-work to mean high water, but even with this increased height the dikes are submerged during storms, tides, and freshets, and are required to be marked by funder piles to enable vessels to enter the harbor at such times without danger of being wrecked upon the concealed dikes.

The appropriations for this harbor, made since the completion of the works in 1880, have been applied exclusively to the repair of the dikes. The improved depths in the channel have been well maintained, but the dikes have greatly deteriorated, partly owing to the ice, partly to the natural decay of the timber, and partly to the undermining of the piles by scours.

The last survey of the harbor was made in 1884, at which time the channel across the bar was 50 to 60 feet wide and 14 feet deep, mean low water, and the shoal on the south side had a least depth of 9.2 feet. A limited examination of the bar was made in June, 1889, but no material changes were discovered in the depths of 1884, further than that the scour along the faces of the dikes had continued, with disastrous results to them.

The eastern end of the south dike was found in a ruinous condition; the central portion had lost the crib-work, which had been built over the original pile-work, and the western part had been raised and greatly distorted by ice. The eastern end of the north dike was canted over towards the channel, and many breaches had been made in the pile-work from end to end of the dike, through which the stone had escaped.

A project was submitted June 11, 1889, for the expenditure of the appropriation of \$5,000, act of August 11, 1888, in making necessary repairs to the dikes, and sealed proposals were invited by public advertisement dated June 21, 1889, for the supply of material and labor. The proposals will be opened July 25, 1889, and it is expected that the repairs will be made during the autumn.

Complaints have been made to this office that the shoal at the entrance to the harbor on the south side, where the depth is only 9.2 feet mean low water, is obstructive to vessels of deep draught and should be removed to a depth of 12 feet mean low water, and that the narrow shoal on the inside, 1½ miles from the light-house, composed chiefly of solid rock or large boulders, over which there is now a depth varying from 5½ to 6 feet mean low water, should be removed to a depth of 10 feet mean low water.

These complaints are well grounded; and the improvements asked for should be granted.

The balance left over after the completion of the project, in 1880 was \$2,705.35, and has since been expended in repairs. Small appropriations for repairs have also been made since 1880, as follows:

Act of August 2, 1882	\$2,000
Act of July 5, 1884	1,000
Act of August 5, 1886	2,500
Act of August 11, 1888	5,000
Total	10,500

An appropriation of \$25,000 is recommended for continuing the improvement, and for making repairs to the dikes, and if appropriated will be applied in dredging the shoal at the entrance to a depth of 12 feet mean low water, in removing the rocky shoal on the inside, $1\frac{1}{2}$ miles west of the light-house, in removing by dredging a sandy shoal adjacent to the rocky shoal, and in repairing the dikes so that they may be able to maintain with efficiency the channel inclosed by them.

The commercial statistics for this harbor for 1888 do not vary greatly from those stated in the Annual Report of 1887, page 665. At that time the tonnage was 2,109,716 tons, with a value of \$14,326,615. It consists principally of coal, lime, cement, and bluestone, and is carried in vessels having a draught of 6 to 15 feet, the number of which, embracing all classes, is about 650. The coal brought in by the Delaware and Hudson Canal for that year amounted to 648,350 tons, and the lime and cement to 304,210 tons. This canal connects the Hudson River at Rondout with the Delaware River at Port Jervis. From Port Jervis it goes by way of the Delaware and Lackawaxen rivers to Honesdale, Pa., where coal is abundant.

The rates of freight and towing have been greatly reduced since the improvements were made at the entrance to the harbor, and the community has been especially benefited by the facilities which are now given to vessels drawing not exceeding 13 feet to enter the harbor at all stages of the tide.

The depth on the bar before the improvements were begun in 1872 was only 7 feet.

Roundout is in the collection district of New York. The nearest works of defense are those of New York Harbor.

AMOUNTS APPROPRIATED.

By act of Congress approved—	
June 10, 1872, diking	\$10,000.00
March 3, 1873, diking	20,000.00
Amount allotted June 8, 1875, from repairs of harbors on Atlantic coast repairs	762.18
From contingencies of rivers and harbors, etc., repairs	237.82
By act of Congress approved—	
August 14, 1876, diking and repairs	30,000.00
June 15, 1878, diking and dredging	30,000.00
By act of Congress passed August 12, 1882, repairs and dredging	2,000.00
By act of Congress approved—	
July 5, 1884, repairs and dredging	1,000.00
August 5, 1886, repairs	2,500.00
August 11, 1888, repairs	5,000.00
Total	101,500.00
Amount expended to June 30, 1889	103.51

Money statement.

July 1, 1888, amount available.....	\$151.22
Amount appropriated by act of August 11, 1888.....	5,000.00
	<hr/>
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	5,151.22 103.51
	<hr/>
July 1, 1889, balance available.....	5,047.71
	<hr/>
{ Amount (estimated) required for completion of existing project.....	25,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	25,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

*Statement of tonnage passing through Delaware and Hudson Canal, for the year ending
December 31, 1888.*

	Net tons.
Cement, lime, brick, etc.....	206,070
Cord-wood.....	32,196
Mill and flagging stone.....	15,461
Merchandise, provisions, etc.....	14,697
Lumber, etc.....	12,172
Sundries.....	13,289
Anthracite coal (other than company's).....	1,935
Anthracite coal (Delaware and Hudson Canal Company's to tide water) ..	1,000,485
	<hr/>
Total.....	1,296,28

E 4.**IMPROVEMENT OF HARLEM RIVER, NEW YORK.**

A full history of this improvement, with the legal proceedings for the acquirement of the land needed for it and copies of the laws passed by the legislature of the State of New York relative thereto, is given in the report of the local engineer in charge to the Chief of Engineers for 1887. (See Report of Chief of Engineers for 1887, Part I, pages 665 to 689.)

The streams embraced in the improvement on the Harlem River and the Spuyten Duyvil Creek, the former emptying into the East River near Hell Gate, and the latter into the Hudson River about 13 miles north of the Battery, and together separating Manhattan Island from the main land.

There has always been an exchange of waters between these two streams at Kingsbridge, though a long ledge of rocks awash at mean low water and an extremely narrow channel at that point have heretofore prevented the exchange being a free one.

High Bridge is practically the head of navigation in the Harlem River, but there is a fair channel of about 10 feet depth at mean low water as far as Morris Dock, 6 miles from the mouth of the river, and a crooked one of 7 feet depth to Fordham Landing, 1 mile further; but there is no navigation of this entire section except by row-boats and a

tion of a section about 30 feet long and nearly the full width of the channel to the proposed depth; and the reduction of the general level of the surface to a plane of several feet below mean low water. Great difficulty has been encountered in sinking a pit in the marsh low enough to drain the work thoroughly, as the soft mud ran into the excavation about as fast as it could be removed; but this has been overcome partially, and the difficulty will decrease soon for want of material to run in.

The experiments for shore protection with crib-work and a timber mattress, which were in progress at the end of the last fiscal year, were continued. The crib-work which was then ready to be sunk was put in place in the trench previously dredged for its reception and sunk on July 14; it was then filled with stone and built up to an average height of about 24 feet. The mattress of round timber was then constructed and sunk in its trench in prolongation of the crib-work August 13. Both the structures were loaded with stone to their full capacity and left to settle. The stone used was furnished from that stored from the cut, and was delivered in the structures by Mr. G. E. Richardson, at the cost of 75 cents per cubic yard. In the early part of October the crib-work was raised by putting on additional courses of timber until it was about 26.7 feet high, and was again filled with stone.

The total length of the crib-work was about 99 feet, and the stone filling amounted to 1,929 cubic yards, and the estimated pressure per square foot upon the bed of the creek was 1,600 pounds. The cost per linear foot, exclusive of the dredging, was about \$46. The mattress was about 41 feet wide and 98 feet long, was loaded with 1,697 cubic yards of stone, and cost about \$22 per linear foot. The settlement into the mud has been slow; but both structures are still going down, the crib-work having settled an average of about four-tenths of a foot and the mattress about two-tenths since November 1, 1888. This settlement will be considerably increased when the channel is dredged alongside of the structures, for they are built in a trench which now confines the mud. The mud at the point selected for the experiments, though very deep, proved to be much stiffer than was supposed, and certainly much stiffer than it is known to be in the marsh south of the foundry and rolling-mill, so that the depth to which a crib-structure can be forced into the mud by weighting it, is still an unsettled question so far as the softer places are concerned.

An attempt was made to further develop the character of the material in the marsh south of the rolling-mill, by sinking a pit. After much trouble in finding some one to undertake the work, a pit was sunk to about 4 feet below the plane of mean low water, when the work was abandoned, as the mud came in at the bottom about as fast as it could be removed with the appliances in use. The total cost of the work, at \$1.50 per linear foot, was \$12.60. The information obtained was that the turf extended down 6 feet below the surface, or to about 1 foot below the plane of mean low water, and had considerable consistency; but underlying it there is a soft grayish mud, which was almost fluid, and apparently extended to the rock, which was 70 feet lower down. In order to obtain information as to the possibility of compressing this soft mud, test borings were made in the yard of Johnson's foundry, where the cinders, from the furnaces had been dumped on the marsh and loaded with piles of coal and pig-iron. At a point where the rock was about 19 feet below the plane of mean low water no turf was found above an elevation of 5 feet below that plane, though its original elevation, before being weighted, was about 5 feet above, and there was no

apparent raising of the turf of the adjoining marsh. An experiment is now in progress for compressing the marsh on the north side of the proposed channel, near the westerly end of the section of the cut under contract, by piling broken stone upon it, but it has not yet progressed far enough to predict the result. If the experience in the foundry yard is to be relied on, there is little doubt that a strong bank can be formed which may be used as a protection to the sides of the channel or the backing of a bulkhead with perpendicular face where it is necessary to retain the full width of the channel without trespass on the land of the riparian owners.

Additional information being required as to the contour of the rock in the section of the cut through Dyckman's Meadow, not under contract, preparatory to building a coffer dam and excavating the material from a portion of it, borings were made there during the month of February, and also in the bed of the Spnyten Duyvil Creek around the bend south of the foundry and rolling-mill.

Mr. J. E. Robinson who made similar borings in the summer of 1887, was employed to do the work at the rate of 50 cents per linear foot and completed it at a cost of \$1,202.05.

After obtaining the information required, a project for the continuation of the excavation of the cut through Dyckman's Meadow, by the expenditure of \$70,000 appropriated by the river and harbor act of August 11, 1888, was prepared and as soon as it was approved, the work was advertised according to law, and bids opened June 11, 1889. Mr. John Satterlee being the lowest bidder, the work was awarded to him and preparations are now in progress for beginning the work.

The appropriation will be applied to the east side of the site of the first contract, and will extend eastward of the existing Kingsbridge Road. A dam will be built on the east side of the bridge proposed to be built by the city, at the point where Broadway extended crosses Dyckman's Creek. The dam will be arranged in such a way that it may be used on the demolition of the Kingsbridge Road Bridge as a highway until the city builds the new Broadway Bridge.

The amount of rock which will be removed under the second contract is estimated at 19,000 cubic yards approximately; leaving 37,000 cubic yards of rock to be removed to complete the estimate for rock removal in the Dyckman Cut, according to computations based upon latest surveys and borings.

The amount that can be profitably expended upon the work during the next fiscal year is \$1,000,000, as it can not be well or economically conducted unless the appropriations are large.

Harlem River is in the collection district of New York. The nearest light-house is on Blackwell's Island.

A full statement of the commerce likely to be benefited by the improvement is given in the annual report of the local engineer officer to the Chief of Engineers for 1887.

(See Annual Report of the Chief of Engineers for 1887, Part I, pages 687, 689.)

AMOUNTS APPROPRIATED.

June 23, 1874, allotment from appropriations for East and Harlem Rivers. \$11,000. 00
By act of Congress approved:

March 3, 1875	10,000. 00
June 18, 1875	300,000. 00
March 3, 1879	100,000. 00
August 11, 1888	70,000. 00

491,000. 00

Amounts expended to June 30, 1889 (inclusive outstanding liabilities) ... 189,927. 35

Money statement.

July 1, 1888, amount available (inclusive amount covered by contract July 1, 1888).....	\$339,544.43
Amount appropriated by act of August 11, 1888	70,000.00
	<hr/> 409,544.43
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$101,941.37
July 1, 1889, outstanding liabilities.....	25,806.69
July 1, 1889, amount covered by existing contracts	163,923.71
	<hr/> 291,671.69
July 1, 1889, balance available	117,872.80
{ Amount (estimated) required for completion of existing project	2,230,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	1,000,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867. *	

Abstracts of proposals for improving Harlem River, New York, received in response to the advertisement, dated April 26, 1889, and opened June 11, 1889, by Lieut. Col. G. L. Gillespie, Corps of Engineers.

Class of work.	Quantity.	* 1. John Satterlee.		2. P. Sanford Ross.	
		Price per unit.	Amount.	Price per unit.	Amount.
Dredging	40,000 cu. yds....	\$40.40	\$16,000	\$40.50	\$20,000
Earth excavation	39,000 cu. yds....	†.30	11,700	†.25	13,650
Rock excavation	19,000 cu. yds....	†1.25	23,750	†1.55	29,450
Round timber	32,000 lin. ft....	†.07	2,240	†.11‡	2,080
Sheet piling.....	200,000 ft. B. M....	\$40.00	8,000	\$30.00	6,000
Pile-driving	40,000 lin. ft....	‡.20	8,000	‡.10	4,000
Square timber.....	22,000 ft. B. M....	‡60.00	1,100	‡44.00	868
Crib-work	78,000 cu. ft....	** .04	3,120	** .05	3,900
Tie rods and screw-bolts	2,600 lbs.....	†.06	156	†.05	130
Iron drift-bolts and washers.....	10,000 lbs.....	†.06	600	†.05	500
Riprap (per sq. yd. of surface).....		.60		1.00	
Total amount bid (except riprap)			74,666		82,278

* Lowest bid.

† In place.

‡ Delivered.

§ Per 1,000 feet, B. M.; delivered.

‡ Driven.

§ Per 1,000 feet, B. M.; in place.

** Framed and sunk.

E 5.

REMOVING OBSTRUCTIONS IN EAST RIVER AND HELL GATE, NEW YORK.

The East River is the name given to the narrow tidal strait which connects New York Harbor with Long Island Sound. It forms an entrance to the harbor of New York secondary in importance only to the main entrance by way of Sandy Hook and the Narrows, since the heavy coasting trade carried on by New York with the New England States and the British American provinces passes almost exclusively through it.

The population now gathered around the waters of New York Harbor numbers nearly 3,000,000, and should the present rate of increase, as shown by the census returns, be maintained for half a century longer, the population would then be about 8,000,000.

New York City can grow in only one direction, and that is into Westchester County, on the north, since on all other sides it is surrounded by water, and the development of the water fronts along the Hudson and the East River must, therefore, be certain and rapid. With this development the importance of the East River entrance to New York Harbor will increase enormously; and within the next fifty years every foot of shore line on both sides of the East River, within 15 miles of Harlem River and Hell Gate, will be occupied with wharves filled with shipping engaged not only in the coasting and transatlantic trade, but in the commerce of the world.

The East River is crooked and narrow in places, and much obstructed by rocks, and affected by violent currents.

The worst of these obstructions is that known as Hell Gate, lying at the mouth of the Harlem River, between Blackwell's and Ward's Islands, about opposite Ninety-sixth Street, New York. Here the river turns at right angles around Hallet's Point, divides into several channels, and runs with a velocity, varying at different stages of the tide, from 3 to 10 miles an hour, over or around Hallet's Point, Negro Point, Ways Reef, Shell Drake, Pot Rock, Frying Pan, Heel Tap, Holmes' Rock, Hog's Back, Flood Rock, Hen and Chickens, Gridiron, The Negro Heads, Mill Rocks, Rhinelanders' Reef, and Bread and Cheese.

On account of the violence and irregularities of the currents and the crowded condition of this passage, wrecks at Hell Gate have been numerous for many years, though they have greatly decreased in number since the improvement of the channel was begun in 1867. At that time some of these rocks projected above the water level, while the least depths over the others at mean low water varied from nothing to 20 feet. The plan adopted was to cut away the rocks and reefs that lay directly in the channel to a depth of 26 feet at mean low water, and to build sea-walls or dikes on some of the others which lay near the edges of the channel, in order to guide the currents and prevent them from rushing over the rocks and carrying them upon the vessels which might come within their reach. Such a wall has been built by the United States between Great and Little Mill rocks, and the city authorities have built a similar protection wall on the reef known as Bread and Cheese, at the head of Blackwell's Island.

The project of improvement, at an estimated cost of \$5,139,120, provided for the removal at Hell Gate to a depth of 26 feet at mean low water of the reef at Hallet's Point, Ways Reef, Shell Drake, Pot Rock, Frying Pan, Heel Tap, Negro Point, and Flood Rock, including the Gridiron, Hen and Chickens, and Negro Heads, and the construction of sea-walls on Mill Rocks, Hog's Back, and Holmes' Rock; and in other parts of the East River for the removal of Diamond Reef and North Brothers Island Reef to a depth of 26 feet, Coenties Reef to a depth of 25½ feet, and the small rocks known as Scaly Rock, Blackwell's Rock, Pilgrim Rock, and the rock off Woolsey's Bath House. This project was modified in 1889 to include reef off Diamond Reef, Reef off Thirty-third Street, and Charlotte Rock, northwest of entrance to Newton Creek, work to be done by hired labor with drill scow.

At the close of the last fiscal year the following parts of this project had been executed: Hallet's Point, covering 3 acres, Ways Reef, Shell Drake, Diamond Reef, North Brothers Reef, Coenties Reef, Scaly Rock, and Pilgrim Rock had been removed to the depth contemplated in the project; Heel Tap had been broken to 26 feet and dredged to 20.5 feet, and the least depths on Frying Pan and Pot Rock were 18 feet and 22.8 feet, at mean low water, respectively; Flood Rock and connecting

covering 9 acres, had been broken to 30 feet, and about one-fourth of the débris had been removed, the Negro Heads and Hen and Chickens having been reduced to 18 feet, mean low water, and a new 18-foot channel, 380 feet wide, opened across the reef. The total cost of this work was \$3,633,893, up to June 30, 1888, not including outstanding liabilities.

These results have been of the greatest value to navigation. The machinery and other plant stored at Astoria, as well as the drill scow and other vessels moored at Mill Rock, have been kept in order during the year.

The expense of taking care of this property is considerable; it deteriorates to some extent with age, and much of it will be out of date if kept much longer. On the other hand, if sold at auction it would bring very little in proportion to what it would cost to replace it. It is apparent that a considerable saving to the United States would result from making the appropriations for this work large enough to admit of putting all this machinery at work before it ceases to be serviceable, without interrupting the work on Flood Rock, the removal of which is an immediate necessity.

Hell Gate is the worst obstruction found in the East River; but there are many other rocks and reefs in other parts of this crowded waterway, which are constant sources of danger to passing vessels, which have often been complained of, and which ought to be removed. There is a long line of reefs and isolated rocks in mid-stream, extending a mile and a half downward from the foot of Blackwell's Island, which have always been troublesome to vessels beating up against the wind, or crossing from one channel to the other, as the winds and tides often compel them to do, and which, with the continually increasing size of vessels, and the increasing commerce of the river, are becoming still more dangerous. The worst of these ought to be removed now. The work of removing, by contract, the stone from Flood Rock, broken by the great blast of October 15, 1855, was suspended April 15, 1888, when the contract with the Atlantic Dredging Company expired by limitation. This was the last of two contracts with that company, and the total amount of stone removed by them was 83,685 tons.

The river and harbor act of August 11, 1888, provides for a survey of the East River from Broome Street to Twenty-third Street. This will be made during the coming season, and a report will be submitted as soon as practicable.

The act of August 11, 1888, appropriated \$250,000 for removing obstructions in East River and Hell Gate, and a project for the expenditure of this amount was submitted October 16, 1888, and approved by the Chief of Engineers, October 29, 1888. Proposals were invited by public advertisement and opened November 21, 1888, for removing broken rock from Flood Rock. But one bid, \$3.50 per ton, was received, and being considered too high, was rejected, with the approval of the Chief of Engineers, November 26, 1888. Negotiations were then begun with a view of obtaining a suitable offer to continue the work by contract, but did not result in any satisfactory bid being received. It was then recommended that the work be re-advertised, and with the approval of the Chief of Engineers, advertisements were issued calling for proposals to be opened, February 14, 1889. The lowest bid, \$2.25 per ton, received in answer to the second advertisement, was still considered too high, and was therefore rejected. Negotiations were then begun with the Atlantic Dredging Company, which was the only Dredging Company that had dredges sufficiently large to do the work

economically, with a view of inducing them to reduce their price per ton for removing the stone, or to hire their plant to the United States on reasonable terms, but no favorable arrangement could be made with them.

These failures to secure a reasonable bid for doing the work by contract left but one alternative, viz, to buy the necessary machinery, and do the work by days' labor. As the construction of new plant would require about one year, and would delay the work on Flood Rock, it was deemed expedient to purchase the plant of the Atlantic Dredging Company, if it could be obtained at an acceptable price. After an examination of the plant had been made in order to permit a correct judgment to be formed of its present condition, the offer of the Atlantic Dredging Company to sell the plant, consisting of two dredges, one tug, two scows, and one water boat, for \$65,500, delivered in good order on the work, was accepted by authority of the Chief of Engineers, June 7, 1889, and the plant was delivered at Flood Rock and accepted June 24, 1889. It began work June 25, 1889, and up to the close of the fiscal year, it is estimated that it has raised and dumped 1,410 tons of broken stone.

A project for the expenditure of \$259,000 available for this work was submitted June 11, 1889, and approved by the Chief of Engineers June 13, 1889. This project provides for working the two dredges on Flood Rock, Hell Gate, for a period of two continuous years, and for the removal by the United States steam-drill scow of the reef off Diamond Reef, the reef off Thirty-third street, and Charlotte Rock. A survey was made in June of the reef off Diamond Reef, between the Battery and Brooklyn, and when the steam-drill scow can be put in working order, this reef will be attacked; not later than July 10, it is expected.

The amount of broken rock to be removed from Flood Rock, at the date of the last survey, August, 1888, to give a channel 26 feet deep, mean low water, over the entire reef is 216,024 tons. The amount which has been removed by contract is 83,097 tons, and by hired labor with the drill scow, 558 tons.

It is believed that the two dredges now at work will remove not less than 60,000 tons per year, and they will therefore require about four years to complete the removal of Flood Rock and connecting reefs.

The suit begun by private parties to dispossess the United States of its occupancy of the dike built by it between Great and Little Mill rocks was decided by the courts in May in favor of the United States, but appeal has been taken by the complainant to a higher court. It is highly important that the United States retain possession of the dike, as the ground is very much needed for wharfage and for repair shops for the steam drill scow and the dredges. If the United States retains possession of this dike, the machinery and other plant now stored at Astoria can be taken there, and the property in store will then be relieved of some of the charges for rent and watching.

The amount that can be profitably expended in the removal of obstructions in East River and Hell Gate in the fiscal year ending June 30, 1891, is \$400,000, to be applied to the removal of Flood Rock, and to continuing the operations of the steam-drill scow on the other obstructions in the East River and Hell Gate, the most prominent of which are Heel Tap, Frying Pan, and Pot Rock within the district of Hell Gate; reef in mid-channel, off sunken meadow; the small reef off Hunter's Point at the southern entrance to the eastern channel around Blackwell's Island, and the principal projections of the long shoal which forms

the western shore of the East River from Grand street to Thirty-fourth street.

The work is in the collection district of New York. The nearest port of entry is New York City. The nearest light-house is Blackwell's Island Light.

A full statement of the commerce making use of Hell Gate will be found in the Annual Report of the Chief of Engineers for 1887, Part I, page 689.

AMOUNTS APPROPRIATED.

By acts of Congress approved—

July 25, 1868.....	\$85,000.00
April 10, 1869.....	178,300.00
July 11, 1870.....	250,000.00
March 3, 1871.....	250,000.00
June 10, 1872.....	225,000.00
March 3, 1873.....	225,000.00
June 23, 1874.....	225,000.00
March 3, 1875.....	250,000.00
August 14, 1876.....	250,000.00
June 18, 1878.....	350,000.00
March 3, 1879.....	250,000.00
June 14, 1880.....	200,000.00
March 3, 1881.....	200,000.00
May 4, 1882.....	50,000.00
By act of Congress passed August 2, 1882.....	200,000.00
By act of Congress approved—	
July 5, 1884.....	360,000.00
August 5, 1886.....	112,500.00
By act passed August 11, 1888.....	250,000.00
Received from other sources.....	3,719.62

3,914,519.62

Deduct amount reverted to United States Treasury	\$3,158.55
Deduct amount allotted to Harlem River.....	11,000.00
	<u>14,158.55</u>

3,900,361.07

Amount expended to June 30, 1889 (inclusive of outstanding liabilities). 3,709,457.64

Money statement.

July 1, 1888, amount available.....	\$16,085.16
Amount appropriated by act of August 11, 1888.....	250,000.00
	<u>266,085.16</u>

July 1, 1889, amount expended during fiscal year, exclusive of	
liabilities outstanding July 1, 1888.....	\$7,943.81
July 1, 1889, outstanding liabilities.....	67,237.92
	<u>75,181.73</u>

July 1, 1889, balance available	190,903.43
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{ Amount (estimated) required for completion of existing project.....	1,238,840.67
{ Amount that can be profitably expended in fiscal year ending June 30, 1891.....	400,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

E. 6.

IMPROVEMENT OF NEWTOWN CREEK, NEW YORK.

Newtown Creek is a sluggish stream about 4 miles long, running through the eastern part of Brooklyn, and emptying into the East River opposite Thirty-fourth street, New York.

In 1857 it had a depth of about 17 feet, which had decreased in 1880 to about 12½ feet at low water from its mouth up to the Vernon Avenue Bridge, a distance of 1,100 feet, its width for this distance being about 240 feet; thence it gradually decreased in width and depth until at the head of navigation, where the Metropolitan avenue crosses it, there was a low-water depth of about 4 feet, and a width of about 100 feet.

A survey of this creek with a view to its improvement was made in 1879, by the engineer officers then in charge, to comply with the act of March 3, 1879, and a report submitted January 31, 1880. The project provided for dredging a channel from the mouth of the creek to Vernon Avenue Bridge, 200 feet wide, and from 21 to 22 feet deep at low water, requiring the removal of 145,000 cubic yards of material, chiefly mud, the cost of which was estimated at \$36,250.

Work under this project was begun in 1880, but by reason of increased cost of dredging the estimated cost was increased to \$44,050.

Under the act of Congress passed August 2, 1882, another survey was made, and a report submitted December 26, 1883 (Annual Report Chief of Engineers, 1884, page 765).

The new project provided for carrying the improvement from the Vernon Avenue Bridge up to the head of navigation in both branches of the creek. The estimated cost of executing this project was as follows

To excavate a channel 18 feet deep and 175 feet wide, from Vernon Avenue Bridge to the Central Oil Works, 143,500 cubic yards excavation, at 30 cents.	\$43, 050
Thence 15 feet deep, and from 125 to 150 feet wide, to Queens County Oil Works, 101,600 cubic yards of excavation, at 35 cents per cubic yard	35, 560
Thence 12 feet deep, and 125 to 150 feet wide, to Nichols' Chemical Works, 52,600 cubic yards excavation, at 40 cents per cubic yard	21, 040
Thence 10 feet deep, and from 100 to 125 feet wide, to the head of navigation on both branches, 231,600 cubic yards excavation, at 40 cents per cubic yard	92, 640
Contingencies	19, 229
To which must be added the revised estimate for work below Vernon Avenue Bridge, before given	44, 050

Total estimated cost of improving Newtown Creek 255, 569

Up to June 30, 1886, \$45,000 of this amount had been appropriated, and with it the channel below Vernon Avenue Bridge had been given a depth of 18 feet, with a width varying from 75 feet at the bridge to 150 feet at the mouth of the creek; and channels 10 feet deep and from 50 to 200 feet in width had been dredged from Covert's Dock up to the bridge at Metropolitan avenue and Grand street on the west branch, and to Grand Street Bridge on the east branch, the distance being about 3,000 and 1,000 feet, respectively.

The act of Congress approved August 5, 1886, appropriated \$37,500 for the improvement, but directed that \$9,375 should be expended on the west branch between Maspeth avenue (Covert's Dock) and what is called the Dual Bridge, at Grand street and Metropolitan avenue; \$9,375 on the main branch between Easterly Grand Street Bridge and Metropolitan avenue, and the balance on the lower end, from Maspeth avenue to the mouth.

Work under this act was completed by contract September 12, 1887. Seventy thousand cubic yards of material were excavated between East River and Vernon Avenue Bridge, resulting in a channel 18 feet deep, mean low water, with a width varying from 200 feet at the entrance to 140 feet at the bridge. Twenty-five thousand one hundred and seventy-five cubic yards were removed from the easterly branch between Grand street and Metropolitan Avenue Bridge, giving a channel 100 to 125 feet wide and $8\frac{1}{2}$ to 10 feet deep, mean low water; and 25,071 cubic yards were removed from the westerly branch between Maspeth Avenue and Dual Bridge, giving a channel of the same width and depth as on the eastern branch.

From the foregoing statements it will be observed that the amount appropriated up to and inclusive of act of August 5, 1886, was \$82,500, of which amount the sum of \$50,750 has been applied from Vernon Avenue Bridge to the East River, and \$31,750 from Covert's Dock, up-stream, to the head of navigation on both branches. These appropriations were made in small amounts and at wide intervals, and the work done by them gave only temporary relief. The reach of the creek between Vernon Avenue Bridge and Covert's Dock has never been improved, for the reason that up to 1886 this part of the river had not been reached in the execution of previous projects, which provided for the work to begin at the entrance and to advance progressively up-stream, and because the act of August 5, 1886, was so worded that part of the money was required to be expended upon the upper river, along the two branches. It would have been better had the appropriation of 1886 been made in such a way that the improvement above Vernon Avenue Bridge could have been executed as an extension of the improvement below it. Then as the improvement advanced up-stream the wharves along the banks would have been benefited progressively and in proportion to their importance. The act of August 11, 1888, appropriated \$25,000 for continuing the improvement, a portion of which, in the discretion of the Secretary of War, might be applied in the improvement of the West Branch. Preliminary to the preparation of a project for the expenditure of this money, a new survey of the creek from the mouth to the head of navigation was made in January. A study of the resulting chart showed that the channel below Vernon Avenue Bridge, which had been improved in 1887, had deteriorated throughout in both width and depth. In the first 1,600 feet below the bridge the width had been reduced to 100 feet, and on the bar at the entrance the navigable depth was only 16 feet mean low water in a channel not exceeding 75 feet wide.

Between Vernon Avenue Bridge and Maspeth Avenue Bridge the depths had slightly increased, but above Maspeth Avenue the depths had shoaled about $3\frac{1}{2}$ feet in both branches.

The amounts of material required to be excavated to complete the original project of 1879 and the extended project of 1883, computed from the survey of January, 1889, are as follows:

	Cubic yards.
For a channel 200 feet wide and 21 feet deep, mean low water, from entrance to Vernon Avenue Bridge.....	102,340
Thence 175 feet and 18 feet deep to the Central Oil Works.....	137,419
Thence 150 feet wide and 15 feet deep to Queens County Oil Works.....	97,032
Thence 125 to 150 feet wide and 12 feet deep, to the Nichols Chemical Works.....	61,123
Thence 100 to 125 feet wide and 10 feet deep, to Metropolitan Avenue bridges, on both branches.....	170,707
Total.....	568,621
This excavation, at 30 cents per cubic yard, would cost \$170,586.30.	

These quantities include an allowance of one-half foot for over-depth, and 33½ per cent. increase in bulk for scow measurement.

In preparing a project for the improvement it was kept in mind that the draught of vessels going above Vernon Avenue Bridge, where the most important wharves are located, was limited by the then available depth of water, and many of the vessels had to be lightened at the bar to facilitate entrance at high tide, while those going out had to complete their cargoes after they reached East River. It was therefore thought best to make the depth below Vernon Avenue Bridge 21 feet and above that bridge 18 feet, mean low water.

By authority of the Secretary of War, contained in second indorsement, dated February 11, 1889, upon a letter from this office dated February 5, 1889, an open-market agreement was made with Mr. James A. Simmons, of New York, for the expenditure of the appropriation of \$25,000, act of August 11, 1888, towards the removal of 120,000 cubic yards of material from the creek at the rate of 18½ cents per cubic yard, measured in scows. The excavation was directed to be made as follows:

	Cubic yards.
For opening a channel 100 feet wide and 21 feet deep from Vernon Avenue Bridge to East River.....	50,000
For opening a channel 75 feet wide and 18 feet deep from Vernon Avenue Bridge to Central Oil Works.....	50,000
Removing middle ground opposite Queens County Oil Works to a depth of 10 feet	10,000

This method of expending the money was the most economical and advantageous to the Government for the reason that all the bids received and opened in this office November 21, 1888, in answer to public advertisement issued according to law for improvements provided by the act of August 11, 1888, and located in and about New York Harbor, varied in price from 23½ cents per cubic yard, the minimum, to 39 cents per cubic yard, the maximum. These bids were considered excessive and were all rejected, and when Mr. J. A. Simmons made to this office a written proposal, dated January 21, 1889, to do the dredging required to be done at Newton Creek, in connection with that required at other adjacent points, for the sum of 18½ cents per cubic yard, his bid, on my recommendation, was accepted by the War Department.

Work was begun under the agreement April 25, and up to the close of the fiscal year 7,738 cubic yards have been removed from the creek, resulting in a channel 20 feet wide and 21 feet deep, mean low water, beginning at the bar and running eastward towards Vernon Avenue Bridge.

The bed of the creek in the area worked over was variable below the plane of 18 feet mean low water; near the bar it was composed of sand, or sand and clay mixed, but as the bridge was approached it grew harder like hardpan, and had large boulders embedded in it. The range of the tides in the creek is about 4½ feet, but the bed of the creek has no natural slope. The creek is the receptacle for all the refuse from the sewers, factories, and slaughter-houses of the east of Brooklyn; constant deposits are therefore forming in it, especially at the upper end, from these causes and from the caving in of the unprotected banks, which consist of marsh mud. To remedy this difficulty, annual dredging will be needed until the banks are protected by bulkheads throughout their whole length. The commerce of the creek is so large that this improvement should be pushed at least 3 miles up from the mouth as soon as possible, so that vessels drawing 20 to 23 feet may pass in and out of the creek with full cargoes at or near low water.

The total annual tonnage accommodated by the creek is estimated at 75,000,000 tons, and embraces almost every article of commerce which finds a market at the port of New York. The money value of the commerce has been estimated to exceed \$50,000,000.

An appropriation of \$100,000 is recommended for continuing the improvement, and if appropriated will be applied in extending the improved channel by dredging from Central Oil Works towards the head of navigation and in widening the channel now under contract.

This work is in the collection district of New York; nearest port of entry, New York City; nearest light-house, Blackwell's Island Light; nearest port, Fort Columbus.

Amounts appropriated.

Date.	Application.	Amount.
June 14, 1880.....	Dredging below Vernon Avenue Bridge.....	\$10,000
August 2, 1882.....	Dredging below Vernon Avenue Bridge.....	15,000
July 5, 1884.....	Part applied above Vernon Avenue Bridge.....	20,000
August 5, 1886.....	Below and above Vernon Avenue Bridge.....	37,500
August 11, 1888.....	Newtown Creek and Bay.....	25,000
	Total.....	107,500

Money statement.

July 1, 1888, amount available	\$1,542.83
Amount appropriated by act of August 11, 1888.....	25,000.00
	<hr/> 26,542.83
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$2,046.65
July 1, 1889, outstanding liabilities.....	911.15
July 1, 1889, amount covered by existing contracts.....	20,768.47
	<hr/> 23,726.27
July 1, 1889, balance available	2,816.56
	<hr/>
{ Amount (estimated) required for completion of existing project	148,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	100,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

E 7.

IMPROVEMENT OF BUTTERMILK CHANNEL, NEW YORK.

Buttermilk Channel is the name given to the channel which separates Governor's Island, at the mouth of the East River, New York Harbor, from the city of Brooklyn, which lies east of it.

The channel on the northwest side of Governor's Island which separates it from the lower end of the city of New York is the wider and the deeper of the two, and is the channel most used by vessels passing between the East River and the other parts of New York Harbor.

Buttermilk Channel is obstructed by three shoals:

1. A shoal lying above and northeast of Governor's Island, projecting into Buttermilk Channel, and extending over to the main channel on

the other side, which originally had a least depth over it of $9\frac{1}{2}$ feet at mean low water.

2. A shoal, putting out from Red Hook Point, on the Brooklyn side, and extending up to the eastern side of the channel to the entrance of the Atlantic Basin, with a least depth on it of about 5 feet at mean low water.

3. A shoal putting out from the southern side of Governor's Island and extending towards the Red Hook Point shoal, which is partly dry at mean low water.

A narrow and crooked channel about 30 feet deep lies between the two latter shoals.

Between the first-mentioned shoal and Governor's Island is a narrow channel with 30 feet of water in it, and between this shoal and the Brooklyn shore there is a channel of the same depth, also originally narrow, but widened now to about 900 feet.

The line of docks and wharves from the Brooklyn Bridge down to the mouth of the Atlantic Basin on the Brooklyn side is one of the most important in the New York Harbor, and this part of the river, extending from the Brooklyn Bridge to Governor's Island, is regarded by pilots and masters of vessels as one of the most difficult places in New York waters to carry a vessel through safely, on account of this shoal, the rapid current, and the enormous traffic passing, and not only up and down, but across the stream.

Tows, tugs, small steamers, and small craft generally in passing up and down this part of the East River keep to the New York side, forcing the larger class of Sound steamers, ocean steamers, and sea-going ships in tow of tugs to keep over towards the shoal at the upper point of Governor's Island, and if, as is often the case, these vessels are obliged to stop in order to avoid collision with ferry-boats, sloops, and canal-boat tows, they are liable to drift upon this shoal.

Upon a statement of these difficulties, made by shipping merchants and others whose business lay along the Brooklyn wharves between Wall Street Ferry and the Atlantic Basin, a survey of this shoal was ordered in 1872, and a project for its improvement was adopted in 1880.

This provided for the removal, to a depth of 26 feet, at mean low water, of such parts of this shoal as lay within 850 feet of the line of the Brooklyn wharves.

The estimated cost of this improvement was \$210,000. Up to June 30, 1886, \$180,000 were appropriated for improvements, by the expenditure of which 466,276 cubic yards of material were removed, deepening the water in the channel between the shoals and Brooklyn to 22–24 feet mean low water over a width of 850 feet. The part removed included the original crest of the shoal, leaving no part of it on which there was less than 17 feet, mean low water. In the annual report for 1885 it was recommended that the channel on the east side be widened from 850 feet to 1,150 feet, unless it should be decided to remove the whole shoal to a depth of 26 feet mean low water, for which the estimate of \$170,000 was given.

The act of August 5, 1886, appropriating \$56,250, practically approved the project for removing the whole shoal, since this appropriation was larger than the amount recommended for widening the channel only.

The improvement by dredging was continued under contract in 1887, and the depth of water over the shoal was increased to 22 feet mean low water, except in a few isolated spots where the depth varied from 17 to 19 feet.

The annual report for 1888, page 612, says that, according to the survey of 1884, 165,000 cubic yards of material were required to be removed from the shoal to give the desired depth of 26 feet mean low water and that the estimated cost for completing the improvement was \$95,000.

The act of August 11, 1888, appropriated \$100,000 for continuing the improvement. A detailed survey of the shoal was made in July and August, 1888, and it was estimated by the officer in charge that the entire removal of the shoal, including the deposits, natural and artificial, which had been made since the work began, would require the dredging of about 425,000 cubic yards. Sealed proposals were invited by public advertisement for this work October 30, 1888, and publicly opened November 21, 1888, at the time stated in the advertisement. The lowest bidders were the Atlas and Hercules Dredging Company of New York, the price bid being 15 cents per cubic yard, but as this bid was made with the impracticable proviso that a dumping-ground for the material raised should be found within one mile of the site of the work, it was rejected. The other bids, which ranged from 27½ cents per cubic yard, the minimum, to 34 cents per cubic yard, the maximum, were regarded as excessive, and were likewise rejected.

On January 21, 1889, Mr. James A. Simmons, of New York, made a written proposition to do the dredging for 18½ cents per cubic yard. This was considered a reasonable bid, and was accepted by authority of the Secretary of War February 11, 1889, and a formal written contract was accordingly entered into with him February 27, 1889, for the removal of 500,000 cubic yards of material at the price of 18½ cents per cubic yard, stated in his proposal. It was understood at the time the bid was offered that the contractor would have to build a plant especially for the work, as he had stated that he neither owned nor could procure in the market a machine of the character he wished to use.

The date of commencement of the work was therefore fixed for June 1. The contractor made a contract immediately with a reputable firm for the construction of a large machine, deliverable on or before June 1.

The machine was not delivered upon the work at the date given, but it is so nearly finished that I have reason to think that it will be ready to go upon the work early in July.

A reef or shoal in this part of the river, lying only about 350 feet north of Diamond Reef, which was removed in 1879-'80, is an obstruction to navigation, since there is a depth of about 20 feet only on it at mean low water.

The commerce of this part of New York Harbor is very large, consisting of all the East Indian, West Indian, South American, and most of the continental European trade. This is carried principally in steamers drawing from 19 to 23 feet of water.

The number of sea-going vessels using the wharves adjacent to Buttermilk Channel for the fiscal year ending June 30, 1887, was 4,150, with a tonnage of 3,058,504 tons, and the value of the merchandise which they carried was \$154,829,062. This, however, does not take into consideration the coastwise and passing trade.

It is expected that the funds now available for the execution of the contract with Mr. James A. Simmons, dated February 24, 1889, will suffice to remove all of the shoal covered by his contract. When this is completed, and the shoal 350 feet north of the former site of Diamond Reef has been removed, the spacious water-way between Brooklyn and New York, immediately east of Governor's Island, will be free from all known obstructions to commerce. No appropriation is recommended

for continuing the improvement during the fiscal year ending June 30, 1891.

This work is in the collection district of New York. The nearest port of entry is New York City, and the nearest work of defense Fort Columbus, New York Harbor. The amount of revenue from customs collected is the amount collected at the port of New York.

Amounts appropriated.

Date.	Application.	Amount.
June 14, 1880	Dredging	\$60,000
Mar. 3, 1881	.....do	60,000
Aug. 2, 1882	.....do	60,000
July 5, 1884	.....do	10,000
Aug. 5, 1886	.....do	56,250
Aug. 11, 1888	.....do	103,000
	Total	346,250
	Received from other sources	100
		346,350

Money statement.

July 1, 1888, amount available	\$5,857.16
Amount appropriated by act of August 11, 1888	100,000.00
	105,857.16
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1881	\$1,016.17
July 1, 1889, amount covered by existing contracts.	92,500.00
	93,516.17
July 1, 1889, balance available	12,340.99

Abstract of bids for improving Buttermilk Channel, New York Harbor, by dredging, opened at the U. S. Engineer Office, Army Building, New York, November 21, 1888, at 12 o'clock m., under advertisement of October 30, 1888.

No.	Name and address of bidder.	Name and residence of sureties.	Price per cu. yard.	Total amount of bid.
			<i>Cents.</i>	
1	Thomas Potter, Jersey City, N. J.	{ William Pothe, Jersey City, N. J. }	34	\$80,000
2	Henry Du Bois' Sons, New York City.	{ Joseph M. Potter, Rahway, N. J. }	27½	80,000
3	W. H. Beard, Brooklyn, N. Y.	{ D. T. Trundt, New York City. }	29	80,000
4	P. Sanford Ross, Jersey City, N. J.	{ Jaspar Murphy, New York City. }	31½	80,000
5	Atlas and Hercules Dredging Company, New York City.	{ C. N. Kimpland, Brooklyn, N. Y. }	*15	80,000
6	Morris and Cumings Dredging Company, New York City.	{ D. M. Hurlvy, Brooklyn, N. Y. }		
		{ Henry Smith, Jersey City, N. J. }		
		{ John Smith, Jersey City, N. J. }		
		{ Cyrus Palmer, Westfield, N. J. }		
		{ Andrew S. Church, Brooklyn, N. Y. }		
		{ John D. Keyes, New York City. }	29	80,000
		{ James D. Leary, New York City. }		

* Provided dumping-ground can be had for the dredged material within 1 mile of the dredging work.

E 8.

IMPROVEMENT OF GOWANUS BAY, NEW YORK.

Gowanus Bay is a part of New York Harbor, lying at the mouth of Gowanus Creek, in the southwestern part of the city of Brooklyn. The depth of water in the channel was formerly from 7 to 12 feet at mean low water, which was wholly insufficient for the passage of the vessels employed in the commerce of the district. A survey of Gowanus Bay and Creek was made in 1880, and a project for their improvement was submitted in January, 1881.

This project provided for dredging a channel between the pier lines established by the commissioners appointed by the State of New York in 1875, beginning at the bay and extending up the creek to Hamilton Avenue Bridge, 18 feet deep at mean low water, and 200 feet wide, except for the upper few hundred feet near the bridge, where the width was to be gradually reduced from 200 feet to 100 feet.

The total length of the proposed channel was about 9,000 feet.

The estimated cost of this improvement was as follows :

530, 00 cubic yards of dredging, at 30 cents per cubic yard.....	\$159, 000
Contingencies	23, 50
Total.....	182, 50

The proposed channel, however, did not follow the old channel at the mouth of the creek, since the pier line established by the commission crossed the old channel at that point and the land under water inside of it, including the bed of the old channel, had become private property.

The owners of this property, Messrs. Beard & Robinson, were anxious, nevertheless, to have the old channel improved instead of having the new one formed, as proposed, outside of the established pier line; but as this could not be done, they surrendered their right to build out to the pier line; they signed a paper relinquishing their right to build piers which should obstruct the old channel so long as that channel should be permitted to exist; and the Maritime Association of New York at the same time petitioned that the old channel should be kept open. As the improvement of this channel would, however, help only the land near it on the north side, and not at all that which lay on the opposite or southerly side of the creek, General Newton recommended that the conflict of interests be settled by dredging the natural channel from the Hamilton Avenue Bridge down to the southwest corner of the Erie Basin; and that from that point two channels should be dredged—one running northerly along the west side of the Erie Basin to deep water near Red Hook, and the other running southerly along the wharves on the south side of the bay toward Bay Ridge.

Both of these channels were to be 200 feet wide, and 18 feet deep at mean low water.

This project required for its execution a larger amount of work than the original scheme called for, namely:

The excavation of 583,530 cubic yards of material, which, at 30 cents per cubic yard, would cost	\$175, 059. 00
Contingencies, 10 per cent.....	17, 505. 90
Total.....	192, 564. 90

The legal measures necessary for securing the right of way across Beard & Robinson's property, at the mouth of the creek, were not completed satisfactorily until May, 1883; but under appropriations of 1881, 1882,

and 1884 the proposed Red Hook branch of the channel was dredged 100 feet wide for a length of 2,000 feet, measured from Red Hook, and the Southern Channel, running towards Bay Ridge, was begun at the southern end, and carried northward for a distance of 1,900 feet, with depths in it varying from 21 to 17 feet, except for a few hundred feet at the upper end on the eastern side, where the last cut was left unfinished.

The act of Congress approved August 5, 1886, appropriated \$7,500 for continuing the improvement. The funds were applied by contract in 1887 in making a cut 1,500 long, 40 feet wide, and 18 feet deep mean low water, along the northern channel line of the creek from a point opposite the foot of Twenty-third street to one opposite the foot of Sixteenth street, Brooklyn. The overlying mud ran into the dredged channel so readily that when the contract was closed, March 12, 1887, the cut was 40 feet wide at the bottom and from 55 to 75 feet wide at the top, with a depth of only 15 feet. At that date the condition of the improvement in Gowanus Bay and Creek was as follows:

What may be called the Red Hook Channel, running round the Erie Basin to the mouth of the creek, had been practically completed for its full width and depth, and the channel leading from it up the creek had been completed to within 2,100 feet of Hamilton Avenue Bridge, with a farther extension of 15 feet deep and 40 feet wide at bottom for 1,500 feet farther up the creek.

What may be termed the Bay Ridge Channel, south of the mouth of the creek, had been begun at its outer or southern end, and had been carried up with nearly full depth and width to a point 2,000 feet south of the mouth of the creek.

The following work then remained to be done to complete the project:

The completion of the channel up the creek 2,100 feet to the Hamilton Avenue Bridge, and the extension of the southern or Bay Ridge Channel northward, so as to connect with the Red Hook Channel at the mouth of the creek.

A sketch of the work, June 30, 1885, may be found in the Annual Report, Chief of Engineers, for that year, part 1, page 672.

Under the estimate of \$192,564.90, only \$72,500.00 had been appropriated to June 30, 1887.

In the Annual Report for 1888, page 615, it is stated:

Large manufacturing and shipping interests are growing up along the banks of the creek, for which the present depth of 18 feet at the mouth, and 8 feet at the upper end of the creek are wholly inadequate.

In 1871, when the first project for its improvement was adopted, 18 feet was the depth of water which the commercial men interested in the improvement asked for; now owners of the water fronts are petitioning for 21 feet, and yet only half of the original project has been completed.

Apart from the creek, the Red Hook and Bay Ridge channels in the bay, as stated in my Annual Report for 1886, page 723, are very important to passing commerce, and would be used when completed by vessels of a large class.

A letter from one of the leading merchants of New York and Brooklyn, published on page 713, Annual Report for 1887, inclosing a petition signed by many firms interested in the improvement of both Gowanus Bay and Buttermilk Channel, gives a fair idea of the growing necessities of the commerce of the port of New York, which seems to indicate the need of the early completion of this improvement.

From this letter it appears that there is not now enough wharf room in the harbor, vessels frequently having to pay a bonus of \$75 or \$100 a day for the privilege of using wharves for which there is a constant demand, and that the improvement of Buttermilk Channel and the Gowanus Bay channels, which constitute a very large part of the water-front of Brooklyn, and which are included in the East River district, of which 63.7 per cent. of the commerce of the port of New York make use, would give very great

relief, especially if the low-water channel depth were increased to 21 feet, instead of 18 feet, as was proposed last year, since it would permit the construction of many more wharves.

To complete the Gowanus Bay channels as originally proposed, making them 200 feet wide and 18 feet deep at low water, would require, under previous estimates, the expenditure of \$120,000. The work could be much better and more cheaply executed were this whole amount made available in one appropriation.

But there can be no doubt that these dimensions are too small in view of the great increase in length and draught which has taken place lately in the construction of sea-going vessels, especially steamers. The depth of these channels ought to be increased now to 21 feet at low water, and their width to 400 feet, while to facilitate the handling of vessels in the contracted space near the mouth of Gowanus Creek, more room should be gained by cutting away the angle on the south side.

To make these changes in the channels would involve the removal of 1,345,000 cubic yards of material in place as follows:

Red Hook Channel—

To deepen it to 21 feet.....	cubic yards..	70,000
To widen it to 400 feet.....	do.....	100,000
		170,000

Bay Ridge Channel—

To deepen it to 21 feet.....	cubic yards..	250,000
To widen it to 400 feet.....	do.....	275,000
		525,000

Gowanus Creek Channel—

To deepen it to 21 feet.....	cubic yards..	350,000
To cut away the angle.....	do..	300,000
		650,000

Total in place.....		1,345,000
Which at 40 cents per cubic yard would cost.....		\$538,000
Contingencies.....		\$62,000
Total.....		\$600,000

The river and harbor act of August 11, 1888, making appropriation for improving channel at Gowanus Bay, New York, reads as follows:

Continuing improvement by dredging to 21 feet mean low water, and widening the channel to 400 feet on the northerly side from the foot of Percival street along the wharves to the 23-foot curve opposite the entrance to Erie Basin, \$60,000.

This provided for the commencement of the first and third parts of the project recommended in the annual report of 1888, modified, so far as regards the width of the new channel by the existing width of the creek. The required width of 400 feet at the entrance could not be obtained without dredging inside the pier and bulkhead line established by the State in 1875, and in the upper 3,000 feet of the creek could not be made 400 feet wide without interfering with vested rights of property above water on the west side to such a degree as to practically prohibit the execution of the project. These circumstances led the local officer, in his project of October 19, 1888, for the application of the funds, to recommend that the channel to be ultimately dredged should be 400 feet wide from the entrance to the eastern end of the Erie Basin, and carried thence 250 feet wide to the foot of Percival street, where provision would be made for again widening the channel by dredging out the three triangular spaces or slips on the north side immediately below that street. The project was approved by the War Department, and sealed proposals for applying the funds, which were invited by public advertisement, were opened November 21. The lowest bidders were the Atlas and Hercules Dredging Company of New York, and the price

bid was 15 cents per cubic yard, with the proviso that the bid did not include "ledge matter or hard pan." The next lowest bid was 29½ cents per cubic yard, and the highest bid was 39 cents per cubic yard.

The bid of the Atlas and Hercules Dredging Company was rejected, after a delay of sixty days, through their failure to give satisfactory evidence of their ability to do the work, or to provide suitable arrangements for the proper disposal of the material after its removal. The other bids were considered excessive and were likewise rejected.

On the 21st of January, Mr. James A. Simmons made a written offer to do the work at 18½ cents per cubic yard. This was accepted, and a formal written contract was made with him February 27, for the removal of 300,000 cubic yards, at 18½ cents per cubic yard, so as to open a channel 100 feet wide and 21 feet deep at mean low water from the entrance to Percival street, and to provide a turning ground for vessels by excavating the triangular slips below the latter point. The right of way granted to the United States in May, 1883, over the lands under water, held by Messrs. Beard and Robinson, covers the northern 200 feet of that part of the proposed channel of 400 feet which lies east of the southwest corner of Erie Basin. The executors of Jeremiah P. Robinson, deceased, gave on the 18th of February, 1869, an additional right of way over all lands owned by them fronting the proposed channel on the upper creek.

Work began at the entrance to the creek under the contract with Mr. Simmons, April 16, 1889, and is now in progress. Up to the close of the fiscal year 38,938 cubic yards of material have been removed, and the improved channel has been carried 25 feet wide and 21 feet deep, mean low water from the entrance along the Erie Basin to Percival street.

The wrecks of two canal-boats were found in the channel at or near the eastern end of the Erie Basin during the last week in May, and as the contractor was unable to remove them by the use of his machine, circular letters were sent to the principal wrecking companies soliciting proposals for their removal. The Atlantic Dredging Company was the lowest bidder, and the wrecks were removed by them the first week in June for the gross sum of \$450 for the entire work.

A detailed statement of the commercial statistics of Gowanus Bay and Creek is given in the Annual Report of Chief of Engineers, 1888, page 616. The tonnage reported then is 793,027 tons, having an estimated valuation of \$12,320,000.

The original estimate of the project for improvement in 1881 was \$192,564.90.

The estimated cost of the project for improvement in 1888 is \$600,000.

Gowanus Bay is in the collection district of New York City. Nearest light, Robins' Reef. Nearest work of defense, the fort on Governor's Island, 1 mile to the northward.

Amounts appropriated.

Date.	Application.	Amount.
March 30, 1881.....	Dredging	\$40,000
August 2, 1882.....	do	20,000
July 5, 1884.....	do	5,000
August 5, 1886.....	do	7,500
August 11, 1888.....	do	60,000
	Total	132,500

An appropriation of \$100,000 is recommended for continuing the improvement, and if made will be applied in dredging, so that the project may be completed so far as relates to the Red Hook Channel and to the Gowanus Creek Channel, making the former 400 feet wide and 21 feet deep, and the latter 250 feet wide and 21 feet deep, mean low water.

Money statement.

July 1, 1888, amount available.....	\$53.31
Amount appropriated by act of August 11, 1888.....	60,000.00
	60,053.31
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$4,411.66
July 1, 1889, outstanding liabilities.....	3,826.66
July 1, 1889, amount covered by existing contracts.....	48,296.47
	56,534.79
July 1, 1889, balance available.....	3,528.52
{ Amount (estimated) required for completion of existing project..... 540,000.00 Amount that can be profitably expended in fiscal year ending June 30, 1891 100,000.00 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of bids for improving Gowanus Bay, New York, by dredging, opened at the U. S. Engineer Office, Army Building, New York, November 21, 1888, at 12 o'clock m., under advertisement of October 30, 1888.

No.	Name and address of bidder.	Names and residences of sureties.	Price per cubic yard.	Total amount of bid.
			<i>Cents.</i>	
1	Thomas Potter, Jersey City, N. J.	William Poths, Jersey City, N. J.; Joseph M. Potter, Rahway, N. J.	39	\$54,000
2	Henry Du Bois' Sons, New York City.	D. T. Trundy, New York City; Jasper Murphy, New York City.	33	54,000
3	P. Sanford Ross, Jersey City, N. J.	Henry Smith, Jersey City, N. J.; John Smith, Jersey City, N. J.	34½	54,000
4	W. H. Beard, Brooklyn, N. Y.	C. N. Kempland, Brooklyn, N. Y.; D. M. Hurley, Brooklyn, N. Y.	29½	54,000
5	Atlas and Hercules Dredging Company, New York City.	Cyrus Palmer, Westfield, N. J.; Andrew S. Church, Brooklyn, N. Y.	15	54,000
6	Morris and Cummings Dredging Company, New York City.	John D. Keyes, New York City; James D. Leary, New York City.	34½	54,000
7	Elijah Brainard, New York City.	Joseph Loughlin, New York City; George W. Lefevre, New York City.	31	54,000

E 9.

IMPROVEMENT OF NEW YORK HARBOR, NEW YORK.

New York Harbor is the name applied to the waters surrounding the city of New York, comprising parts of the Hudson, East, and Harlem rivers, and the upper and lower bays lying respectively inside and outside of the Narrows, and between the Long Island, Staten Island, and New Jersey shore.

The city of New York, from which the harbor takes its name, lies at the mouth of the Hudson River at its junction with the East River, and with the adjacent cities of Brooklyn and Jersey City, which are but the natural outgrowths of New York energy and enterprise, includes a

population of nearly 3,000,000 inhabitants, which is more than the population of any State in the Union excepting New York, Pennsylvania, Ohio, Illinois, and Missouri.

At this port two-thirds of the merchandise imported into the United States is received, and two thirds of the import duties are collected. From this port are sent out one-half of the domestic products of the country which are exported, and here one-half of the foreign tonnage trading with the United States enters. Three-quarters of the passengers traveling between the United States and foreign countries come and go by way of New York, and three-fifths of all immigrants land at Castle Garden.

New York Harbor has two entrances—one by the East River and Hell Gate, leading into Long Island Sound, used chiefly by vessels trading between New York, the Eastern States, and the British American Provinces; the other, which is the main entrance, leading out through the Narrows, by Sandy Hook, directly into the Atlantic Ocean.

The Hell Gate entrance has been in course of improvement since 1869, and with its successful completion—which is now assured within a few years—and with the steady growth of the city towards the north, it must come more than ever into use by foreign-bound vessels.

The main, or Sandy Hook, entrance into New York Harbor is one of the best in the world; the channel prior to 1884 was less than 24 feet deep at mean low water, and nearly 29 feet at mean high water, with abundant breadth, and no need for deepening it was ever felt after that date, until within the last few years, when the great increase in the length, tonnage, and draught of the trans-Atlantic passenger steamers made further deepening necessary, in order to prevent the delays to which they have been subjected by having to wait for high water in order to pass either in or out.

Before the improvement of the main entrance into New York Harbor was undertaken by the United States, it was obstructed by four shoals, as follows:

1. The outer bar, about 4,000 feet wide, the channel across which is known as Gedney's Channel, where there were depths of 23.7 feet in mid-channel, and 22.3 feet in the southern half.

2. The shoal at the mouth of the Swash Channel, about 4,000 feet wide, where the depth was 24.3 feet.

The channel across this shoal has been named the Bayside Channel.

3. The shoal northwest of Sandy Hook, about 2,000 feet wide, on which the least depth was 26.2 feet.

4. The shoal in the Main Ship Channel in the lower bay, west of Flynn's Knoll, nearly 3 miles long, on the crest of which the depth was only 23.9 feet in mid-channel, with depths of 22.6 feet within a few hundred feet of the mid-channel range.

A large proportion of the vast commerce of the port, which is carried on in vessels of great draught, could only cross these shoals at, or near, high water.

The project for the improvement of Gedney's Channel was approved by the Secretary of War in December, 1884, and its extension to cover the whole of the main entrance to the harbor received his approval December 27, 1886.

It provides for dredging a channel 1,000 feet wide and 30 feet deep at mean low water, from deep water below the Narrows, through the Main Ship Channel and Gedney's Channel, to deep water outside the bar; maintaining this channel, should it be necessary, either by periodical dredging or by contracting the entrance by the construction of a dike

running across the shoals from the Coney Island side, with suitable protection for the head of Sandy Hook to prevent its being scoured away by the increased current.

The estimated cost of obtaining the dredged channel is \$1,490,000, and the entire cost of the improvement should the contraction works prove to be necessary, is estimated at between \$5,000,000 and \$6,000,000.

Under this project an extended survey of the lower bay had been made on which the method of improvement was based.

At the close of the last fiscal year two contracts were in force for the improvement of the channels at the entrance,—one with the Joseph Edwards Dredging Company, dated April 27, 1887, for the removal of 700,000 cubic yards from Gedney's Channel; and another, dated May 19, 1887, for the removal of 1,500,000 cubic yards from the Main Ship Channel. Both contracts expired by limitation December 1, 1889.

Owing to the difficult character of the material in the Main Ship Channel, and also to the delays which the contractors had experienced in getting the different machines ready for work, it became apparent, in the autumn of 1887, that the contractors could not possibly, unaided, remove by December 1, 1888, the amounts specified in the contracts. It therefore became necessary to provide supplementary plant to assist with the work, and arrangements were accordingly made in May, 1888, after protracted negotiations, with Messrs. Brainard Brothers, for the removal of 200,000 cubic yards, and with Mr. Joseph Cumings for the removal of 800,000 cubic yards, both amounts to be removed from the Main Ship Channel, west of Flynn's Knoll, at 28½ cents per cubic yard, the price fixed in the original contract with the Joseph Edwards Dredging Company. With this additional plant it was hoped that the Joseph Edwards Dredging Company would be able to complete both contracts by December 1, 1888. The contract for Gedney's Channel was not quite completed December 1, 1888, and by authority from the Chief of Engineers, December 6, 1888, it was extended to December 31, 1888. The number of cubic yards actually removed on its completion, December 22, 1888, was 740,410 cubic yards.

The contract for the Main Ship Channel was not completed December 1, 1888, by the Joseph Edwards Dredging Company, even with the assistance of the additional plant supplied by the agreements entered into in May with Messrs. Brainard Brothers, and with Mr. Cumings. At that date, the Joseph Edwards Dredging Company had removed 589,890 cubic yards, only and Messrs. Brainard Brothers had removed 82,909 cubic yards only. Mr. Joseph Cumings had not perfected his machine, and had done no work. On the application of the contractors, the contract with the Joseph Edwards Dredging Company, dated May 19, 1887, together with the agreements which had been made with Messrs. Brainard Brothers, and with Joseph Cumings, dated May 10 and 11, 1888, respectively, was, by authority from the Chief of Engineers, dated December 3, 1888, extended to June 30, 1889, with the proviso that the quantity to be removed by Mr. Joseph Cumings at the expiration of the extended agreement should be limited to 200,000 cubic yards.

On December 8, 1888, a proposition was received from the Joseph Edwards Dredging Company to dredge from the Gedney's Channel division about 600,000 cubic yards, which it was estimated would complete the improvement projected for that division, at 17 cents per cubic yard, in accordance with the specifications governing the execution of their contract which had just expired, with the reservation that no deduction should be made for over-depths of less than 1 foot from the payments due to them for work done by them under the agreement. This proposition was approved by the Chief of Engineers December 15, and the

agreement was accordingly made with the Joseph Edwards Dredging Company, with the limitation that the work should be completed by January 1, 1890. On the 23d December, 1888, the machine employed by Messrs. Brainard Brothers withdrew from the work and went into winter quarters and did not resume operations again till April 18, 1889. The Joseph Edwards Dredging Company worked uninterruptedly throughout the winter with their machines; one dredge working the Main Ship Channel, one dredge on the Bayside Channel, and one dredge at the Northwest Shoal, near western end of Bayside Channel. During the month of January a survey of Gedney's and Bayside channels was completed, and the results were communicated to the public by a notice to mariners, given to the press January 25. At that time Gedney's Channel had a depth of 30 feet, mean low water, between parallel lines 50 feet and 550 feet, respectively, south of the line of buoys G₂ and G₆; the Bayside Channel had a depth of 30 feet, mean low water, between parallel lines 50 feet and 570 feet, respectively, south of the line of buoys B₂ and B₆. In the Main Ship Channel, west of Flynn's Knoll, the least depth between lines 100 feet and 500 feet, respectively, west of the line of buoys C₂ and C₆, was 27 feet at mean low water, where formerly 22.6 feet only, mean low water, existed. On May 2 the work for deepening the Northwest Shoal, at the western end of the Bayside Channel, was suspended until a survey was made to ascertain whether the computed amount of 79,021 cubic yards, which had been actually removed from the shoal, would complete the project for a channel 1,000 feet wide and 30 feet deep at mean low water, where 26.7 feet only formerly existed. After that time until the close of the year two of the machines belonging to the Joseph Edwards Dredging Company and one to Messrs. Brainard Brothers were concentrated upon the Main Ship Channel, west of Flynn's Knoll, where they will be retained until that work is completed under existing contracts, reserving one machine to complete the projected channel across the bar in Gedney's Channel, under the agreement of December 15, 1888, with the Joseph Edwards Dredging Company. The experiment of using dumping-scows to receive and transport to the dumping-ground the material raised by the pumps has been successfully tried by the Joseph Edwards Dredging Company, and the same method it is stated will be adopted at an early day by the Messrs. Brainard Brothers. The pumping-machine of the last-named contractors is arranged in a vessel which has no propelling power, and it is expected that the great loss of time heretofore consumed in towing to sea the machine, and the material which it has pumped into its self-contained bins, will be much lessened by the future use of scows, which will permit the present machine to remain constantly upon the site of the work, while the scows alone are towed to sea. This method by the use of scows will be adopted for all fair-weather work, but a return to the old method will have to be made doubtless when the weather is boisterous.

A survey of the Main Ship Channel from below the Narrows out along the improved channel to deep water beyond the bar, was made in June, and the resulting charts will soon be published for the information of mariners. These charts, which were first published in December, 1888, in separate sheets, covering the several sections of the improved channel, and which are printed on a scale convenient for ready reference, have been eagerly sought after by all the steam-ship companies of the port, to whom they have been liberally distributed free of charge.

The survey just completed shows that the improvement is in the most gratifying condition. There is no indication that Gedney's Channel has shoaled since the last survey of December 29, 1888, when the least depth in the channel width of 500 feet was 30 feet at mean low water. The Bayside Channel is entirely free from the small shoal spots which formerly existed in it, at or near the eastern entrance to the Swash Channel, and the line of deep water is now direct from the western entrance to Gedney's Channel, westward to the southern entrance to Main Ship Channel opposite to Red Buoy No. 10, and the least depth throughout the entire width of 1,000 feet is 30 feet at mean low water.

The Main Ship Channel, west of Flynn's Knoll, from Buoy No. 10, the northern limit of the 30-foot curve in Sandy Hook Bay, to Buoy No. 12, the extreme northern limit of the present improvement, has 29 feet at mean low water between parallel lines 50 feet and 550 feet, respectively, west of the line of buoys C₃, C₄. The 30-foot channel between the same extreme north and south points has an average width of 350 feet.

When it is remembered that before this improvement began, in 1885, the least depth in Gedney's Channel was 22.3 feet, in Bayside Channel 24.3 feet, and in the Main Ship Channel, west of Flynn's Knoll, 22.6 feet—all at mean low water—the great results attained by the work just reported will be quite apparent. The noticeable result is that there is now a navigable channel from the wharves at New York City to the sea, affording 30 feet depth, approximately, at mean low water, and 34.8 feet at mean high water, and that it is practicable for the largest steamer which visits the port to pass in and out over the bar in fair weather without regard to the tides.

The quantity of material required to be removed from the Main Ship Channel to obtain a channel 1,000 feet wide and 30 feet deep, mean low water, from 30-foot curve at Sandy Hook Bay to Buoy No. 12, the limit of present improvement, in addition to the quantities now under contract with the Joseph Edwards Dredging Company, dated May 19, 1887, is 586,638 cubic yards, and to extend the improvement northward so as to connect the improved channel with the 30-foot curve of the deep water below the Narrows 633,808 cubic yards additional are required to be removed, making the grand total of 1,220,446 cubic yards. At the rate of 28½ cents per cubic yard, the present price, the estimated cost will be \$350,000, approximately.

On the expiration of the contract with the Joseph Edwards Dredging Company, dated December 8, 1888, for the improvement of Gedney's Channel, it is expected that that improvement will be completed.

The following table shows the performance of dredges throughout the year:

Name of dredge.	Main Ship Channel west of Flynn's Knoll.	Bayside Channel.		Gedney's Channel.	Total dredged.
		Eastern end.	Northwest Shoal.		
Joseph Edwards Dredging Company, contractors:	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>	<i>Cubic yards.</i>
Advance	55,524	221,682	51,285	25,470	332,961
Mt. Waldo	438,419	25,480	42,068	.....	506,967
Reliance	158,993	38,906	4,768	240,790	431,647
Brainard Brothers:					
Leo	123,402	.....	.....	.....	123,402
Total	775,338	274,158	79,021	266,260	1,294,777

Quantities removed by the several contractors since the beginning of the improvement in 1885.

	Cubic yards.
From Gedney's Channel.....	769,097
From Bayside, eastward.....	397,451
From Bayside, westward (Northwest Shoal).....	79,021
From Main Ship Channel west of Flynn's Knoll.....	1,037,431

The amount of material excavated by the four machines used during the month of May was 145,504 cubic yards, the highest record for any one month since the improvement began. The *Mount Waldo*, belonging to the Joseph Edwards Dredging Company, excavated and dumped 70,123 cubic yards during the month of June, by the use of scows, the highest record of any single machine.

The relative capacities of the machines used by the two contractors may be seen by an inspection of the following table showing the results for the month of June, 1889:

	Cubic yards.
The Joseph Edwards Dredging Company:	
Dredge <i>Mount Waldo</i>	70,123
Dredge <i>Reliance</i>	40,385
Brainard Brothers:	
Dredge <i>Leo</i>	19,926
Total.....	130,434

This work is in the collection district of New York. Nearest light-houses, Sandy Hook and Highlands lights. The nearest forts are the fort at Sandy Hook and those at the Narrows.

Amount of revenue from customs collected at the port of New York during the year ending June 30, 1889:

AMOUNTS APPROPRIATED.

For Gedney's Channel:	
By act July 5, 1884.....	\$200,000.00
For New York Harbor:	
Act August 5, 1886.....	750,000.00
Act August 11, 1888.....	380,000.00
Total.....	1,330,000.00

Amount expended to June 30, 1889, inclusive of outstanding liabilities. 808,411.74

Money statement.

July 1, 1888, amount available (inclusive amount covered by contract July 1, 1888).....	\$544,110.95
Amount appropriated by act of August 11, 1888.....	380,000.00
	924,110.95
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$335,971.89
July 1, 1889, outstanding liabilities.....	66,550.80
July 1, 1889, amount covered by existing contracts.....	206,006.86
	608,529.55
July 1, 1889, balance available.....	315,581.40
{ Amount (estimated) required for completion of existing project.....	160,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891.....	160,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

794 REPORT OF THE CHIEF OF ENGINEERS, U. S. ARMY.

*Statement of the number and tonnage of all vessels belonging to the port of New York
June 30, 1889.*

	Number.	Tonnage.
Under 20 tons:		
Sail	373	4,155.33
Steamer	183	4,544.64
Sail, fisheries	1	12.50
Above 20 tons:		
Sail	2,170	167,591.22
Steam		
Barges		
Canal boats		
Temporary		
Yachts, sail and steam	218	18,670.88
Fisheries, sail and steam	8	1162.50
Frontier, sail and steam	1	183.36

*Gross tonnage.

†Net tonnage.

Coastwise vessels.

Entrances	2,296
Clearances	2,003

Commercial statistics of the port of New York for the fiscal year ending June 30, 1889.

	Number.	Registered tonnage.
Foreign vessels entered	3,573	4,747,463
Foreign vessels cleared	3,580	4,635,635
American vessels from foreign ports	1,395	810,480
Coastwise vessels entered	2,398	(*)
Coastwise vessels cleared	2,003	(*)
American vessels cleared	1,046	736,716

*Tonnage not given.

Amount of revenue collected	\$147,094,618.45
Value of all imports	479,418,125.60
Value of all exports	397,370,945.00

E 10.

IMPROVEMENT OF RARITAN BAY, NEW JERSEY.

Raritan Bay forms the western part of the large triangular bay inclosed between Sandy Hook, the New Jersey shore, and Staten Island, the eastern part of which is commonly known to New Yorkers as the Lower Bay, as it lies just outside of or below New York Harbor, which is the name usually applied to the inner body of water on which the city of New York is situated.

The Raritan River flows into Raritan Bay at its extreme western end, passing between Perth Amboy and South Amboy, and Newark Bay is connected with both the Raritan River and bay by the Arthur Kill and Staten Island Sound, which, separating Staten Island, belonging to the State of New York, from the New Jersey shore, enters Raritan Bay at Perth Amboy.

The depth of the bay varies from 5 to 30 feet, decreasing gradually towards its western and southern shores.

The natural channel leading out of it, after passing the Great Beds Light at the junction of Staten Island Sound and the Raritan River, does not follow the middle of the bay, but hugs the Staten Island shore for nearly 4 miles to Seguine's Point, situated about half a mile east of Prince's Bay Light, then it runs southeastwardly towards the inner point of Sandy Hook about 2 miles, crossing a shoal which puts out towards the southward from the Staten Island shore.

In 1880, before any improvement had been made here by the Government, 18 feet at mean low water could be carried through from Perth Amboy to Great Beds Light; while there was not less than 21 feet of water from Great Beds Light to Seguine's Point, to deep water in the outer bay only 14½ feet of water could be carried across the shoal.

The width of this shoal between the 21-foot curves was about 8,000 feet.

Through the middle of the bay, south of this channel from Great Beds Light directly towards Sandy Hook, only 11 feet of water could be carried over the shoals.

The above depths all refer to mean low water.

A survey of this bay was ordered in 1880, with the view of ascertaining the practicability of securing a greater depth of water from the main ship-channel in the lower bay to the wharves at Perth Amboy, as vessels were often much delayed in crossing the shoal east of Seguine's Point.

The estimated cost of dredging a channel 300 feet wide and 21 feet deep, mean low water, from Seguine's Point southeastward to the deeper waters of the bay outside was \$126,500. (Annual Report Chief of Engineers, 1881, Part I, pages 717-719.)

From March 3, 1881, to July 5, 1884, \$120,000 were appropriated for this improvement, and a survey which was made in May, 1885, showed that the improved channel at that date had an average width of 250 feet, and a least depth of 18 to 20 feet, mean low water.

The channel had slightly shoaled since the dredging was suspended in 1884. In 1885 the project was extended by providing for excavating a channel 300 feet wide and 21 feet deep, from Great Beds Light to deep water at Ward's Point, opposite Perth Amboy. This channel, taken in connection with the one to be dredged outside of Seguine's Point, would give a continuous 21-foot channel from the Main Ship Channel in New York Bay to the wharves at Perth Amboy. The modified project of 1885 further called for dredging a channel from Great Beds Light to South Amboy, 4,500 feet long, 300 feet wide, and 15 feet deep, mean low water. The cost of dredging these two channels, and restoring the original width in the cut, east of Seguine's Point, was estimated to cost \$114,000, which sum was increased in 1888 to \$120,000, to provide for the shoaling which had taken place in the interval of three years. (Annual Report of the Chief of Engineers, 1885, Part I, page 758.) The appropriation of act of August 5, 1886, was \$37,500, and was applied to completing the channel west of Ward's Point, 300 feet wide and 21 feet deep, and in excavating a channel 315 feet wide and 21 feet deep across the crest of the shoal leading from the bend towards Seguine's Point, but the funds were not sufficient to complete the whole of the projected work at that point.

The act of August 11, 1888, appropriated \$25,000 for continuing the improvement.

The project for applying the funds under the act towards deepening the Seguine's Point Channel in the section where the existing depth

was less than 18 feet, was approved, and sealed proposals for doing the work were received after public advertisement, November 21, 1889. The lowest bid was at the price of 23½ cents per cubic yard, and the highest, 29½ cents per cubic yard. As they were considered too high, they were all rejected.

On the 21st of January, 1889, Mr. James A. Simmons, of New York, made a written offer to do the dredging at 18½ cents per cubic yard, and as his proposition was considered reasonable and just, it was accepted. A contract was made with him February 27, 1889, for the removal of 120,000 cubic yards of material from the channels in Raritan Bay, leading to Seguine's Point and to South Amboy, at the rate of 18½ cents per cubic yard, measured in scows. The contractor made immediately a contract with the Osgood Dredging Company for the manufacture of a suitable plant, deliverable about June 1. The machine was not delivered at the date fixed, but it is so well advanced towards completion that I have good reason to believe that it will be ready for work not later than July 10. By authority received from the Chief of Engineers, February 25, 1889, not more than \$8,000 of the appropriation of August 11, 1888, for improving Raritan Bay will be expended upon the improvement of the channel leading from Great Beds Light to South Amboy.

It was stated in the original project of 1881 that the Seguine's Point Channel would have to be maintained by dredging. The detailed survey which was made in 1888, from the eastern end of the Seguine's Point Channel to Perth Amboy showed that considerable shoaling had taken place both in the improved channel and over a large stretch west of Prince's Bay Light where deep water formerly existed. This fact makes it necessary to submit new and revised estimates for the further improvement of the channels leading to Perth Amboy and to South Amboy.

REVISED ESTIMATE.

1. For a channel 300 feet wide and 21 feet deep, mean low water, from New York Lower Bay to Perth Amboy, the following dredging will be required:

	Cubic yards.
a. From 21 foot-curve, New York Lower Bay, to 21-foot curve off Seguine's Point	347,368
b. From Prince's Bay around Red Buoy 8, towards Great Beds Light.....	154,130

Total dredging	501,498
2. For a channel 300 feet wide and 15 feet deep from Great Beds Light to South Amboy, the dredging required will be.....	200,000

These estimates are made on the basis of an allowance of 1 foot over depth, and for one-third increase of bulk for scow measurement.

Total dredging required for the completion of the two projected channels, cubic yards	701,498
Estimated cost of the proposed dredging	\$175,375

The advantages to commerce and benefits to the community which will follow the completion of this work are that the heavier-draught vessels will be able to reach the wharves at Perth and South Amboy without the delay caused by low water and grounding.

This work is in the collection district of Perth Amboy, which is the nearest port of entry. Nearest light-house, Prince's Bay; nearest fort, fort at Sandy Hook, N. J.

Amounts appropriated.

Date.	Application.	Amount.
March 31, 1881	Dredging	\$50,000
August 2, 1882	do	50,000
July 5, 1884	do	20,000
August 5, 1886	do	37,500
August 11, 1888	do	25,000
		<hr/> 182,500

An appropriation of \$100,000 is recommended for continuing the improvement, and if made will be applied towards the execution of the project, for which an estimate of \$175,375 is submitted in this report. The commerce of these channels is very large, and attention is invited to the statistics specially prepared in 1887, which do not differ from those of to-day.

Money statement.

July 1, 1888, amount available	\$1,007.72
Amount appropriated by act of August 11, 1888.....	25,000.00
	<hr/> 26,007.72

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$610.30
July 1, 1889, amount covered by existing contracts.....	22,200.00
	<hr/> 22,810.30

July 1, 1889, balance available	3,197.42
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{ Amount (estimated) required for completion of existing project.....	175,375.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	100,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of bids for improving Raritan Bay, New Jersey, by dredging, opened at the U. S. Engineer Office, Army Building, New York, November 21, 1888, at 12 o'clock m., under advertisement of October 30, 1888.

No.	Name and address of bidder.	Name and residence of sureties.	Price per cubic yard.	Total amount of bid.
			<i>Cents.</i>	
1	Thomas Potter, Jersey City, N. J.	William Pothe, Jersey City, N. J., and Joseph M. Potter, Rahway, N. J.	23½	\$22,500
2	Henry DuBois's Sons, New York City.	D. T. Trundy and Jasper Murphy, New York City.	29	22,500
3	W. H. Beard, Brooklyn, N. Y.	C. N. Kimpland and D. M. Hurley, Brooklyn, N. Y.	29½	22,500
4	P. Sanford Ross, Jersey City, N. J.	John Smith and Freeman A. Smith, Jersey City, N. J.	25	22,500
5	Morris and Cumings Dredging Company, New York City.	John D. Keyes and James D. Leary, New York City.	(*)	.....

*Bid incomplete; price not stated.

COMMERCIAL STATISTICS.

Commerce and navigation for the fiscal year ending June 30, 1887, at the port of Perth Amboy, N. J.

	Vessels entered.		Vessels cleared.	
	Number.	Tonnage.	Number.	Tonnage.
Coastwise.....	353	90,065	72	47,254
American.....	2	305	21	7,439
Foreign.....	31	34,574	62	51,589
Total.....	386	124,944	155	106,262
Value of imports.....	\$1,019,739.00			
Value of exports.....	410,814.00			
Duties collected.....	146,690.12			

Vessels belonging to the port of Perth Amboy June 30, 1887.

	Number.	Tonnage.
Sailing-vessels.....	272	13,064.26
Steam-vessels.....	42	7,301.56
Barges.....	60	18,488.79
Canal-boats.....	2	265.81
Total.....	376	39,140.54

*Many canal-boats carrying coal from South Amboy are not documented, and the number and tonnage are unknown.

The statistics as given by the collector of the port of Perth Amboy do not cover the entire traffic through Raritan Bay.

All the freight from the Delaware and Raritan Canal, Raritan River, and South Amboy enters the bay at the mouth of the Raritan River.

At the Great Beds Light, about $1\frac{1}{2}$ miles southeasterly from the South Amboy docks, this freight tonnage, which is estimated at 3,692,458 tons for the past year, is divided, and, according to the estimates of Hon. D. C. Chase, superintendent of the Delaware and Raritan Canal Towing Line, and Mr. A. C. Davis, shipping and terminal agent, 5 per cent. of it, or 184,623 tons, goes through the channel of Raritan Bay.

Of the Perth Amboy tonnage, according to the estimate of Mr. I. L. Fisher, president Vessel Owners' Association, 5 per cent., or 103,498 tons, goes out through this same channel.

There is, therefore, in addition to the measured or registered tonnage of vessels passing through Raritan Bay, as given by the collector, an estimated actual freight tonnage—

	Tons.
From South Amboy.....	184,623
From Perth Amboy.....	106,498
Total.....	293,121

Estimated value of same, \$2,344,968.

The principal articles of commerce are coal, iron, iron ore, steel, oil, brick, pottery, clay, and manufactured articles of clay.

The effect of the work of improvement upon rates of freight, insurance, and competing routes of transportation are not appreciable.

A comparison of the entrances and clearances at the port of Perth Amboy for the years 1881 and 1887 shows the following increase:

	Per cent.
Number of vessels entered.....	370
Tonnage of vessels entered.....	263
Number of vessels cleared.....	49
Tonnage of vessels cleared.....	143

A like comparison of the amounts of duties collected for the same years shows an increase in revenue of 291 per cent.

Commercial statistics of the port of Perth Amboy, N. J., for the fiscal year ending June 30, 1889.

	Number.	Registered tonnage.
Foreign vessels entered.....	26	25, 293
Foreign vessels cleared.....	99	81, 669
American vessels from foreign ports.....	2	381
American vessels for foreign ports.....	25	10, 073
Coastwise vessels entered.....	150	89, 537
Coastwise vessels cleared.....	85	39, 729
Amount of revenue collected.....		\$59, 632. 83
Value of all imports.....		138, 340. 00
Value of all exports.....		1, 722, 283. 00

E II.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

1. IRON STEAMER ATLAS, NEW YORK HARBOR.

The following description of the *Atlas* was obtained from the agents of the steam-ship line: The steam-ship *Atlas* is an iron-screw steamer; length, 250 feet 3 inches; beam, 29 feet; depth, 17 feet 7 inches; gross tonnage, 1,140 tons. She was sunk in the Hudson River, a few hundred feet off Barclay Street, New York City, after collision with a ferry-boat October 23, 1888.

The depth of water in the river in the vicinity of the wreck is 56 feet at mean low water, and the depth over the pilot-house of the steamer is 14 feet only at mean low water. Sealed proposals were invited by public advertisements dated March 23, 1889, and opened publicly May 4, 1889, for the removal of the wreck. Mr. William E. Chapman was the only bidder, and the price bid was \$14,947. The Merritt Wrecking Company did not offer a bid, for the reason that they had already a contract with the owners for raising the wreck. This company has never abandoned the wreck, and are still at work trying to raise it. If they should be unsuccessful in their efforts, the steamer will be declared derelict, and the contract for the removal will be awarded to Mr. William E. Chapman, in accordance with the authority of the Chief of Engineers dated May 14, 1889.

2. The wrecks of two canal-boats were found in the Gowanus Creek Channel in May, during the process of improving that channel. As the machine of the contractor was not able to remove them, circular letters were sent to all the wrecking companies in the city, May 27, inviting bids for their removal.

Three bids in reply were received, and opened June 1, and the contract was awarded by authority from the Chief of Engineers dated June 5, 1889, to the Atlantic Dredging Company, New York City, at the price of \$450 for the removal of both wrecks. The wrecks were removed in June, and the expenditure was defrayed from the appropriation for the improvement of Gowanus Creek.

Abstract of bids for the removal of the wreck of the steamship Atlas and her cargo, now lying in the Hudson River, near Barclay Street, New York City, opened at the United States Engineer Office, Army Building, New York, May 3, 1889, at 12 o'clock m., under advertisement of March 23, 1889.

No.	Name of bidder.	Name and residence of sureties.	Amount.
1	Wm. E. Chapman...	Charles P. Raymond and James A. Van Brunt, Brooklyn, N. Y..	\$14,847

E 12.

PRELIMINARY EXAMINATION OF TARRYTOWN HARBOR, NEW YORK.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., October 24, 1888.

GENERAL: In compliance with Department letter of September 29, 1888, I have the honor to submit the following report on the preliminary examination of Tarrytown Harbor, New York.

Tarrytown is situated on the Tappan Zee where the Hudson River has a width of several miles, the channel being bordered on both sides by extensive flats. The flat on the eastern shore is about three-eighths of a mile wide measured from the 12-foot contour of the river channel to the wharves of Tarrytown, with depths of 3 feet at mean low tide. A secondary channel extends along the shore with a depth of 4½ feet and affords the present means of access to the wharves.

The improvement desired consists in dredging this channel about 6,500 feet long, to a depth of 8 or 10 feet at mean low water, and width of 200 feet, or else in constructing a long dock from shore to the main channel in the Hudson River. Such an improvement if carried out by the General Government would probably cost in the neighborhood of \$75,000.

Dredging alone without a dike or breakwater would not prove permanent.

Tarrytown has now a population of about 6,000; it is a suburb of New York and is mainly a town of villas and country houses, producing but little for shipment.

The commerce of the place is estimated at about 30,000 tons of coal and building material, with an amount of general merchandise corresponding to the population.

The community is in the main well served by the Hudson River Railroad, and the improvement desired in the water route would not be likely to affect the growth of the place or greatly increase its trade.

I am of the opinion that Tarrytown Harbor is not now worthy of improvement, as the expense would be considerable and the population and interests centered there are not, in my opinion, sufficient to justify it.

Very respectfully, your obedient servant,

GEO. MCC. DERBY,
Captain of Engineers, in Temporary Charge.

The CHIEF OF ENGINEERS, U. S. A.

E 13.

PRELIMINARY EXAMINATION FOR A SHIP-CHANNEL BETWEEN JERSEY CITY AND ELLIS ISLAND, NEW YORK.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., October 24, 1888.

GENERAL: In compliance with the Department letter of September 29, 1888, I have the honor to submit the following report on the preliminary examination for a ship-channel between Jersey City and Ellis Island.

The act of August 11, 1888, in addition to providing for a survey or examination for "a ship-channel between Jersey City and Ellis Island," provides for one also "from the Pier Lithe (pier line) to the main channel, a distance of about 1,650 feet and 700 feet north by northeast from Ellis Island, for a ship-channel or basin between the deep water of Hudson River and Ellis Island." Both of the above items are referred to me for report, but it is believed that they both refer to the same improvement.

The general subject of a ship-channel along the Jersey Flats passing between Ellis Island and Jersey City was reported on by Lieut. Col. G. L. Gillespie, Corps of Engineers, in 1882, and his report is published in Senate Ex. Doc. No. 80, Forty-seventh Congress, first session.

The improvement now desired consists in dredging to a depth of 26 feet mean low water, the area shown in red on the accompanying tracing. I inclose herewith a letter from Mr. D. B. Duncan, vice-president of the North River Coal and Wharf Company, which sets forth the arguments that can be advanced in favor of the United States undertaking the work.

This portion of the New Jersey shore is owned by the Central Railroad of New Jersey, and the North River Coal and Wharf Company have leased for a long term the property indicated on the tracing. They have constructed an immense pier, and are engaged in shipping coal for the Reading Railroad Company and the Beech Creek Company, and propose to construct another similar pier, and attract the business of the Lehigh Valley Railroad and others. Mr. Duncan states that they shipped last year 1,500,000 tons of coal, and the new pier will have a capacity of 2,000,000 more.

I have examined the locality, and it is unquestionably a magnificent piece of property, in the highest degree worthy of improvement. The proposed improvement involves dredging about 1,250,000 cubic yards of mud, and would cost in the neighborhood of \$200,000.

* * * * *

In conclusion, I would report that the ship-channel or basin between New Jersey and Ellis Island is worthy of improvement, and if the Chief of Engineers decides that it is worthy of improvement by the General Government, I estimate the cost of the necessary survey at \$300.

Very respectfully, your obedient servant,

GEO. MCC. DERBY,
Captain of Engineers, in Temporary Charge.

The CHIEF OF ENGINEERS, U. S. A.

SURVEY FOR A SHIP-CHANNEL BETWEEN JERSEY CITY AND ELLIS ISLAND, NEW YORK.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., January 15, 1889.

GENERAL: I have the honor to submit the following report, with illustrative chart, upon the survey for a ship-channel between Jersey City and Ellis Island, New York Harbor, to comply with the river and harbor act of August 11, 1888. A preliminary report on this survey was made by Capt. George McC. Derby, Corps of Engineers, October 24, 1888, to which I respectfully invite attention.

The survey, which was made under the personal direction of Mr. C. S. Kelsey, was begun December 19 and completed January 4. The chart comprises two plans for improvement to meet the requirements of the river and harbor act calling for two distinct examinations of the water space between Ellis Island and Jersey City, viz:

- (1) A ship-channel between Jersey City and Ellis Island.
- (2) From the pier lithe to the main channel, a distance of about 1,650 feet, and 700 feet north by northeast from Ellis Island for a ship-channel or basin between the deep water of Hudson River and Ellis Island.

These two plans of improvement will be considered separately.

1. "SHIP-CHANNEL BETWEEN JERSEY CITY AND ELLIS ISLAND."

Ellis Island, which measures 2.6 acres, lies at the northern end of Jersey Flats, 1,700 feet west of the 26-foot curve on the west side of the main ship-channel leading to the entrance to the Hudson River, and 1,300 feet south from the outer extremity of Fort Liberty to coal wharf, the last wharf built from Communipaw eastward toward the main ship-channel. At the present time there is no navigable channel, properly so called, between the island and the main shore, as the water space has barely a depth of 4 feet mean low stage, except in a depression close in to Port Liberty wharf, where the depth is increased to 14 to 16 feet over a width of less than 25 feet. It is reported that the individuals or corporations controlling property on the south side of Communipaw have done occasional dredging to assist ships in entering the slips between the piers, but as the wharves are located at the point where the waters outflowing from the Hudson River first experience an expansion after leaving the strait between Jersey City and New York City, the velocities are diminished, and the materials held in suspension by the waters have a tendency to be deposited upon the head of the flats, causing shoaling in the channels dredged across the flats. This action will be continuous, and the effect will be to shoal gradually any channel which may be opened to connect the wharves with the main ship-channel of the harbor.

The promoters of this survey, however, desire that such a channel shall be opened. In this connection I invite your attention to section 3, river and harbor act of March 3, 1881, providing for an examination "from a point between Ellis Island and docks of New Jersey Central Railroad to a point between Robbins Reef Light and Constable Hook in waters of New York Bay, New York," having in view the opening of an inner communication, over Jersey Flats, between upper New York Harbor and Kill von Kull. The survey of this inner communication was made under my direction July-August, 1881, and a report submitted to the Chief of Engineers, U. S. Army, dated December 28, 1881 (Annual Report Chief of Engineers 1882, page 719, Part I), containing

1

2

an estimate for the execution of a ship-channel 5 miles long approximately, 300 feet wide, and 21 feet deep, mean low water, excavated partly through a rocky ledge and partly through gravel, sand, and mud, at a total cost of \$7,134,980. The northern end of the channel provided for in the act of 1881 was located between Ellis Island and Jersey City, and covers practically the ground to be occupied by the channel provided for in the act of August 11, 1888.

This report, under act of August 11, 1888, may therefore be considered as presenting an estimate for the excavation of a part of the eastern end of the channel proposed to be opened by the act of 1881.

It will be observed that if the project of 1881 is to be ultimately carried out, the estimate of \$7,134,980 must be largely increased, inasmuch as the depth now required in the eastern section to be improved under the act of 1888 is to be 26 feet deep, mean low water, in place of 21 feet, mean low water, under act of 1881.

Starting, then, the ship-channel at the 26-foot curve of the main ship-channel of New York Harbor, opposite Communipaw, and running westerly 2,375 feet, with a width of 300 feet, to a point 700 feet north by northeast of Ellis Island, there will be required to be removed 333,731 cubic yards of solid material, sand, gravel, and mud, measured in place, or 433,850 cubic yards, measured in scows, at an estimated cost of \$108,462.

This proposed channel will run immediately eastward of Communipaw and give accessibility to Iron, South, Communipaw, Coal, and Port Liberty docks, upon which, it is stated, three millions and over of coal will be handled during the next year. It will provide no increased anchorage for general shipping, but will materially benefit that part of the shipping of the port which is employed in the coal trade. It is believed that the channel once opened will need constant dredging for its maintenance.

2. FOR A "BASIN BETWEEN THE DEEP WATER OF HUDSON RIVER AND ELLIS ISLAND."

A basin has been outlined upon the chart which it is believed conforms to the intent of the act. It is bounded on the south by the prolongation of the dock line west of Port Liberty wharf; on the north and west by the pier line adopted in 1883 by the riparian commissioners of New Jersey, and on the east by the 26-foot contour of the main ship-channel. It measures 70 acres, approximately, and has sufficient capacity to accommodate conveniently 250 vessels at anchor, after allowing an open channel on the north side for convenient communication with the adjacent wharves. This basin, as has already been stated when considering Jersey Flats in general, will be particularly subject to deterioration arising from deposits laid by the river waters and arising principally from Jersey City influences and will need constant dredging for its maintenance.

I have not heard that the port wants additional anchorage for its vessels.

To lower the bed of the basin to the plane of 26 feet below mean low water will require, it is estimated, the removal of 1,361,074 cubic yards of solid material, bowlders, sand, gravel, and mud measured in place, or 1,769,396 cubic yards measured in scows, at an estimated cost of \$442,339.

As the harbor lines for the harbor of New York City have been for some time under consideration by the Board of Engineers appointed by

the Chief of Engineers in compliance with section 12, river and harbor act of August 11, 1888, it would seem inadvisable at this time to change existing conditions on Jersey Flats by provisions for additional improvements, such as form the basis of this report, which would in the least degree embarrass the Board of Engineers in its deliberations or conclusions, or which after or during execution would require future adjustment to the harbor lines which the Board might recommend. It is possible also that the recommendations of the Board in regard to the utilization of the flats and to the establishment of new harbor lines may be such as to conflict with the ready and economical execution of the plans for which estimates are presented in this report.

Jersey Flats are in the collection district of New York and Newark, N. J., both of which are ports of entry. The nearest fort is on Bedloe's Island, and the nearest light-house is on Robbins Reef, Upper Bay, New York Harbor.

The amount of revenue collected at the port of New York for the year ending June 30, 1888, was \$145,300,344.35. The amount collected at Newark for the same period was \$2,613.62.

The amount of commerce which will be benefited by the improvements considered in this report has been estimated at 3,500,000 tons, representing a money value of \$15,000,000. It is stated that during the year ending December 31, 1888, 10,000 vessels were employed to transport the merchandise handled at existing wharves, and that when the new and proposed wharf facilities have been completed the number of transporting vessels required will be increased to 20,000, and the rates for handling and delivering coal will be reduced 50 cents per ton.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

E 14.

ESTABLISHMENT OF HARBOR LINES OF NEW YORK HARBOR AND ITS ADJACENT WATERS.

OFFICE OF THE BOARD OF COMMISSIONERS OF PILOTS,
New York, September 13, 1888.

SIR: I beg leave to hand you herewith a resolution of this Board, calling for the establishment of exterior pier and bulkhead lines in this harbor.

By order of the Board.

Very respectfully,

Hon. WM. C. ENDICOTT,
Secretary of War.

AMBROSE SNOW,
President.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
September 19, 1888.

Respectfully referred to Capt. George McC. Derby, Corps of Engineers, for report.

By order of Major Post, Corps of Engineers, in charge.

THOS. TURTLE,
Captain of Engineers, U. S. A.

[Second indorsement.]

ENGINEER OFFICE, U. S. ARMY,
New York, September 28, 1888.

Respectfully returned to the Chief of Engineers, U. S. Army, with accompanying report.

GEORGE McC. DERBY,
Captain of Engineers.

[Third indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
October 2, 1888.

Respectfully returned to the War Department with the recommendation that the Chief of Engineers be authorized by the Secretary of War to constitute the Board of Engineers stationed in New York City, the *Board to establish the harbor lines of New York Harbor and its adjacent waters* in accordance with section 12 of the act of August 11, 1888.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Fourth indorsement.]

WAR DEPARTMENT, *October 4, 1888.*

Approved as recommended by the Chief of Engineers.

By order of the Acting Secretary of War.

JOHN TWEEDALE,
Chief Clerk.

RESOLUTION OF THE BOARD OF COMMISSIONERS OF PILOTS OF NEW YORK CITY.

OFFICE OF THE BOARD OF COMMISSIONERS OF PILOTS,
New York, September 11, 1888.

At a regular meeting of the Board held this day the following was, on motion, unanimously adopted:

Whereas the maintenance of the channels of the harbor of New York depends upon the preservation of the tidal basins, which are supplied and discharged through said channels; and

Whereas, in some parts of said basins no exterior lines have been established by the States of New York and New Jersey, and in some parts the lines so established are not definitely located; and

Whereas, under the present system, even where such lines are established, the right to encroach beyond them is obtained with too great facility; and such encroachments for the benefit of individual owners are of frequent occurrence: Therefore,

Resolved, That this Board respectfully petition the honorable Secretary of War to cause harbor lines to be established throughout the basins connected with the harbor of New York, as authorized by section 10 of the river and harbor act of August 11, 1888.

Copied from the minutes.

By order of the Board.

AMBROSE SNOW,
President.
D. A. NASH,
Secretary.

REPORT OF CAPTAIN GEORGE McC. DERBY, CORPS OF ENGINEERS.

ENGINEER OFFICE U. S. ARMY,
New York, N. Y., September 28, 1888.

GENERAL: Pursuant to your indorsement of the 19th instant, on the accompanying letter from the President of the New York Board of

Commissioners of Pilots, I have the honor to submit the following report:

The Board of Pilot Commissioners petitions the Secretary of War to cause harbor lines to be established throughout the basins connected with the harbor of New York as authorized by section 10 (12) of the river and harbor act of August 10 (11), 1888, for reasons given.

The reasons are, in my opinion, sound. There can be no question that the depths in the channels of a tidal estuary like New York Harbor depend on the area of the tidal basins which these channels feed.

The value of the real estate on water fronts in and around New York is so very great that it is a constant temptation to every riparian owner to reclaim just as much of the land under water as he possibly can, and to run his docks out into the channels just as far as he is allowed to. To hold this tendency in check to some extent the legislatures of the States of New York and New Jersey have at various times established pier lines and bulkhead lines in those parts of New York Harbor where water-fronts are the most valuable and where consequently the danger from unreasonable encroachment on the channels and tidal basins is greatest. But large areas and miles of channel, just as valuable for the maintenance of the regimen of the harbor, are still without any protection. Two Engineer officers were detailed by the President of the United States in 1877 to co-operate with the authorities of the State of New York in deciding upon harbor lines for a part of the Hudson River, but no meetings were ever held and no action was taken. A commission was also appointed in 1875 to establish lines around Staten Island but their report has never been fully adopted by the State of New York, so that the lines recommended lack the authority of the law.

From these instances it may be seen that the States are not alive to the necessity of protecting the navigable water-ways of the United States lying within their domains; and this is not surprising either since, if the channels are injured, it is to the General Government that the public looks to make good the damage.

It would seem to be only logical that the power that restores should be the one to maintain, and that therefore the control of the harbor lines should by rights be in the hands of the General Government in all cases where the United States is expending funds on engineering works for the benefit of navigation.

But where the opposite banks of the water-way belong to different States, as is the case in many instances around New York Harbor, it is specially important that the United States should take the matter in hand, because the proper consideration of the question demands that both sides of the stream or tidal basin should be considered as one problem.

There has, however, never been co operation between the States of New York and New Jersey in this matter. On the contrary where a commission appointed by the President of the United States recommended certain lines for the two banks of the Kill von Kull, the State of New Jersey failed to adopt them and established its own lines encroaching to a serious extent upon the channel that had been recommended by the commission. The States in such cases are interested parties and should not be permitted to act separately on questions in which their interests are at variance.

Finally, it has always been an easy matter for any strong and wealthy riparian owner to go to the State legislature and get the harbor lines in front of his property altered for his exclusive benefit.

The proper establishment of these lines is not a local question, but involves the consideration of the regimen of the whole system of chan-

nels and basins; it is obvious that when the subject has received this consideration and the problem has been solved by a competent commission, that local alterations should only be made under the most exceptional circumstances.

The duty of preventing encroachments beyond the authorized lines is vested by the State of New York in the Board of Pilot Commissioners, and their petition to the Secretary of War is itself the best evidence of the unsatisfactory working of the present system.

For the above reasons I would recommend that this petition be granted, believing that the establishment of harbor lines throughout the basins connected with the harbor of New York is essential to the protection and preservation of the harbor.

The engineer in charge of each district included in the case under consideration could draw up a plan recommending pier and bulkhead lines for the streams and harbors in his charge, which plan could then be referred to the Board of Engineers, or to a special Board convened for the purpose, on whose report the final lines could receive the recommendation of the Chief of Engineers, and the approval of the Secretary of War. Once these lines are adopted it would be most desirable to make the process of altering them extremely difficult, as by requiring by regulation that no application for a change of the lines be forwarded to the Secretary of War for his approval without the unanimous recommendation of the engineer in charge the Board of Engineers and the Chief of Engineers, and that such recommendation should only be made for weighty reasons.

As the final establishment of the lines would require a great deal of work and considerable time, existing lines established by the State could advantageously be adopted provisionally, so as to put the United States in control at once and prevent any injurious change being made in the State lines pending the final establishment of the lines by the Secretary of War.

The most available official to intrust with enforcing the observance of the lines would appear to be in this case the supervisor of New York Harbor appointed under the act of June 29, 1888; though the work could conveniently be done by the engineer in charge of each district. In either event the officer would be greatly assisted in the performance of this duty by a regulation requiring all parties wishing to build piers of bulkheads to apply to him for a permit, in order that the location of the structure may be properly fixed before it is built.

In this connection it would seem to be desirable that a suitable penalty should be fixed for the violation of such regulations as the Secretary of War may make, which section 12 of the act of August 11 does not appear to provide.

Very respectfully, your obedient servant,

GEO. MCC. DERBY,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

a. HARBOR LINES ON EAST RIVER BETWEEN FIFTY-NINTH STREET AND SIXTY-FOURTH STREET, NEW YORK CITY.

THE BOARD OF ENGINEERS,
New York City, March 26, 1889.

GENERAL: At its meeting of March 20, 1889, the Board constituted by special orders No. 49, Headquarters Corps of Engineers, to estab-

lish harbor lines for New York Harbor and its adjacent waters unanimously adopted the following resolution :

Resolved, That on the receipt of a project in writing covering the views presented verbally yesterday by Mr. George S. Greene, engineer-in-chief of the department of docks of the city of New York, for improving the harbor lines on East River, between Fifty-ninth street and Sixty-fourth street, a special report be made by the president of the Board to the Secretary of War recommending said project for his approval, as this design will not encroach upon the lines which will ultimately be recommended by the Board.

In accordance with this resolution I have now the honor to transmit a copy of a letter this day received from Mr. Edwin A. Post, president of the department of docks, together with a tracing showing the proposed harbor lines, and to recommend that the honorable the Secretary of War be requested to approve the same.

Very respectfully, your obedient servant,

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen.,
President New York Harbor Line Board.

The CHIEF OF ENGINEERS, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
March 29, 1889.

Respectfully submitted to the Secretary of War.

The department of docks of the city of New York desires to establish a new plan for the improvement of the water-front of the city on East River, between Fifty-ninth and Sixty-fourth streets.

It appearing from the within to be the opinion of the Board of Engineer Officers constituted to establish harbor lines for New York and its adjacent waters, that the proposed plan will not encroach upon the harbor lines which will be ultimately recommended by the Board, their recommendation that the plan in question be approved by the Secretary of War is submitted for favorable consideration.

H. M. ADAMS,
Major, Corps of Engineers,
In Charge.

[Fourth indorsement.]

WAR DEPARTMENT, April 11, 1889.

Approved as recommended by the Acting Chief of Engineers, in the first indorsement hereon.

By order of the Secretary of War:

JNO. B. RANDOLPH,
Acting Chief Clerk.

LETTER OF THE PRESIDENT OF THE DEPARTMENT OF DOCKS, NEW YORK CITY.

CITY OF NEW YORK, DEPARTMENT OF DOCKS,
New York, March 25, 1889.

SIR: The department of docks desires and proposes to establish a new plan for the improvement of the water-front, under section 712 of the consolidation act as amended by chapter 517 of the laws of 1884, between Fifty-ninth street and Sixty-fourth street, on the East River; the said new plan will embrace the construction of piers at the foot of Sixtieth street, Sixty-first street, and Sixty-second street, as shown in red upon the accompanying plan; also the construction of the bulkhead wall as shown in blue lines on the accompanying plan.

The department of docks, therefore, submits to you, and the Board of which you are president, its desire and intention, and requests to be informed whether your Board will approve of such new plan, and also what steps are necessary to be taken by this department in order to have the approval of the honorable the Secretary of War.

Very respectfully,

EDWIN A. POST,
President.

General HENRY L. ABBOT,
*Corps of Engineers,
President Board of Engineers.*

b. HARBOR LINES FOR THE NORTH AND EAST SHORES OF STATEN ISLAND, FROM NEW BRIGHTON TO FORT WADSWORTH.

HARBOR LINE BOARD,
New York City, June 4, 1889.

GENERAL: The Board of Engineers for harbor lines of New York Harbor, constituted by Special Orders, No. 49, Headquarters Corps of Engineers, October, 5, 1888, has held several public meetings in this city which have been well attended by interested persons desirous of having modifications made in existing pier lines, and has had under special consideration the papers and charts presented by the Rapid Transit Railroad Company of Staten Island, with an application for an outward advancement of the pier lines on the north and east shores of that island. For a full understanding of the subject the Board will refer briefly to past action in regard to these lines.

The pier and bulkhead lines of Staten Island have been examined and reported upon by two Commissions of Boards of Officers: *First*, a Board of Harbor Commissioners composed of governmental officers, appointed in 1855 by the War Department at the solicitation of the Governor of the State of New York. The shore-line for which pier and bulkhead lines were projected by this Board extended from Fort Wadsworth, north and west through the Kills to Seguine Point, and the results were delineated upon maps, scale 1:20,000. The outer pier-head line for Kill von Kull was made to follow in general the 12-foot curve, and on the east shore of Staten Island the 18-foot curve. These lines were confirmed by the State of New York, chapter 763, act passed April 17, 1857.

Second, a Board of Harbor Commissioners appointed by the War Department, also at the request of the State of New York, in 1875.

After a careful consideration of the subject for a period covering nearly three years, a system of lines was projected in 1878, extending completely around the island. The State of New York confirmed these lines so far as relates to the shore-line from Fort Wadsworth to New Brighton, by act of March 29, 1878, chapter 88.

In 1886 the engineer officer in local charge of the harbor improvements recommended an extension of these latter lines, which was approved by the Secretary of War apparently for the purpose of securing in this way early confirmation by the State. But the State took no action upon the recommendation, and the lines in force to-day around the island are those confirmed by the State acts of New York of 1857 and 1878.

The Staten Island Rapid Transit Railroad Company is particularly anxious that the lines east of the New Brighton, following the eastern shore towards Fort Wadsworth be extended outwards into the bay. While the Board believes that no great injury will be done to the chan-

nels leading into the harbor by a partial advance of the pier-line on the concave eastern shore of the Narrows, it witnesses with alarm any effort which may be made for the material advance into the upper bay by any solid structure or structures which will spring from the north-eastern end of the island near the entrance to the Kill. Long piers at this point will interfere with the tidal currents which flow to and from this water-way, to the actual detriment of the navigation of the port and to the injury of the important tidal reservoirs lying to the westward. The Board has made an examination of the shore-line, upon the ground, and has studied with care the papers and charts referred to it for its information. It now presents upon the accompanying chart a delineation of the lines which, in its judgment, may be adopted without serious menace to the integrity of the Kill von Kull, the harbor, or any of its tributary reservoirs, and which are in advance of lines previously adopted by the State, and will give additional commercial facilities which are demanded. The Board is decidedly of the opinion that the extension is as great as ought to be allowed.

In general the Board recommends that the pier-lines at St. George be pushed out 200 feet beyond the head of the existing pier at that point; that the western branch be joined to the pier and bulkhead line, south shore, or Kill von Kull, at New Brighton Pier, by an easy curve, and that the southern branch be directed southward along the 36-foot curve of the concave eastern shore of the island until it strikes that shore near the northeastern salient of Fort Wadsworth.

This pier-line is more definitely located by offsets from known streets as follows: Beginning at the northeast corner of the pier at New Brighton, 280 feet north of the south side of Richmond Terrace at the intersection with Westervelt avenue, it runs eastward at a distance of 470 feet east from the south side of Richmond Terrace at its intersection with Henry street; thence east at a distance of 800 feet east from the south side of Richmond Terrace at Nicholas street; thence southerly at a distance of 1,145 feet east from the west side of Jay street at the intersection with Hamilton avenue; thence southerly at a distance of 985 feet east from the west side of Brighton Place at the intersection with De Kalb street; thence southerly at a distance of 1,375 feet east from the east side of Stuyvesant street at the intersection with South street; thence southerly at a distance of 1,825 feet east from the east side of Griffin street at the intersection with Arrietta street; thence southerly at a distance of 1,630 feet east from the easterly side of Bay street at the intersection with Washington street; thence southerly at a distance of 2,195 feet east from the easterly side of Bay street at the intersection with Wave street; thence southerly at a distance of 2,130 feet east from the east side of Bay street at the intersection with Canal street; thence southerly at a distance of 1,820 feet east from the west side of Bay street at its intersection with Vanderbilt avenue; thence southerly at a distance of 1,570 feet east from the west side of New York avenue at the intersection with Maple avenue; thence southerly at a distance of 785 feet east from the west side of Bay street at its intersection with Sylva street; thence southerly at a distance of 775 feet east from the east side of Bay street extended at the intersection with Cliff street; thence southerly to the northeast corner of Fort Wadsworth.

From St. George westward to New Brighton the distance of the bulkhead line behind the pier line shall diminish gradually from 400 feet at St. George to nothing at New Brighton. From St. George southward towards Fort Wadsworth this distance of 400 feet shall gradually increase

to 600 feet at Arrietta street, and be kept at that distance as far as Sylva street, and thence diminish gradually to 200 feet at the southern terminus of the bulkhead north of Fort Wadsworth.

Respectfully submitted.

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.,
President of the Board.
C. B. COMSTOCK,
Colonel of Engineers,
Bvt. Brig. Gen., U. S. A.
D. C. HOUSTON,
Lieut. Col. of Engineers,
Bvt. Col., U. S. A.
G. L. GILLESPIE,
Lieut. Col. of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS
U. S. ARMY,
June 19, 1889.

Respectfully submitted to the Acting Secretary of War.

It appearing that the establishment of harbor lines of New York Harbor is essential to the preservation and protection of the harbor, the Acting Secretary of War, by indorsement of October 4, 1888 (papers herewith), approved the recommendation of the Chief of Engineers that the Board of Engineers stationed in New York City be constituted the Board to establish the harbor lines of New York Harbor and its adjacent waters in accordance with section 12 of the river and harbor act of August 11, 1888.

The Board having submitted the within report and accompanying tracing on which the proposed lines for the north and east shores of Staten Island from New Brighton to Fort Wadsworth are drawn, it is recommended that the lines selected be approved, and that the approval of the Secretary be placed upon the tracing submitted.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

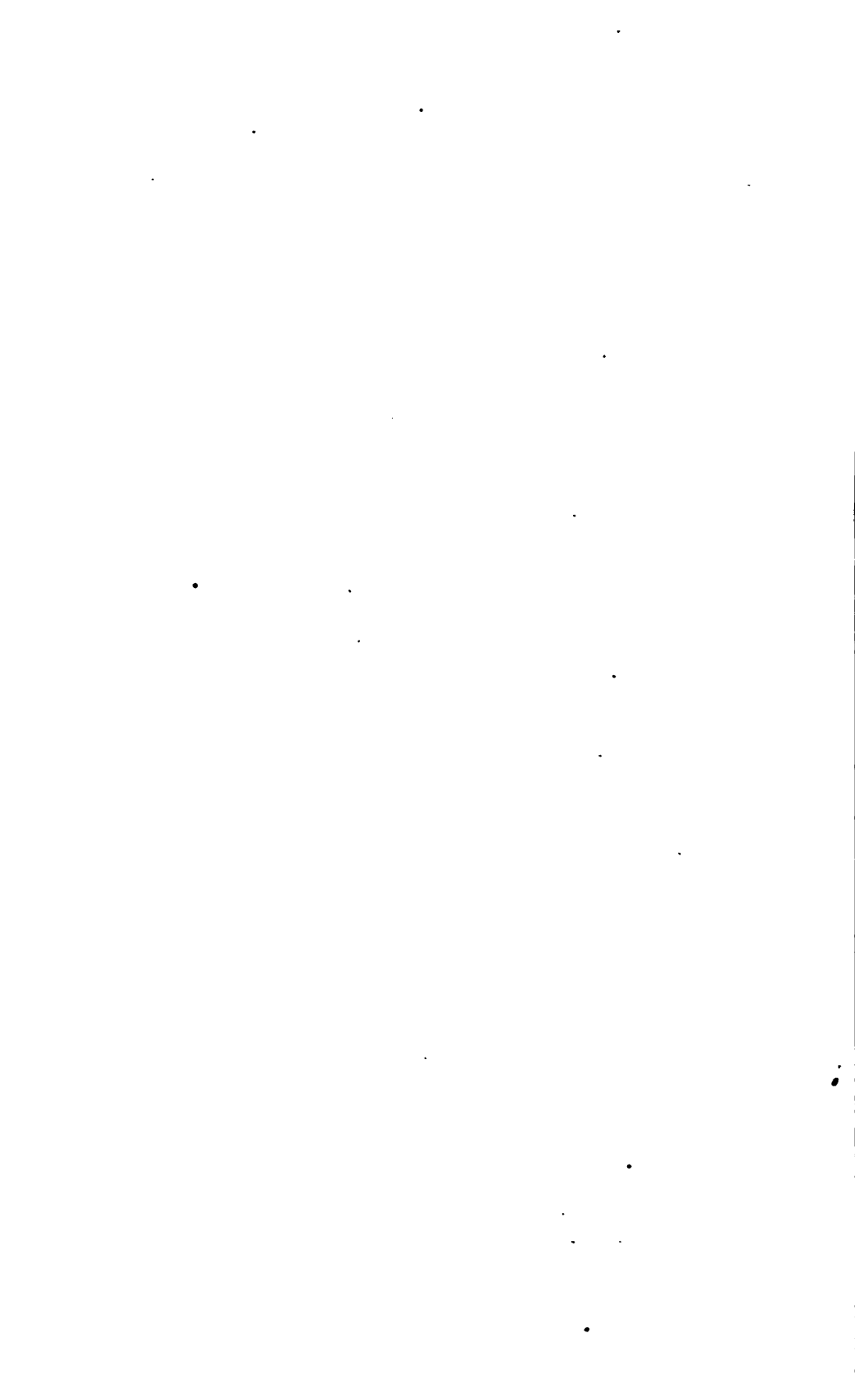
[Second indorsement.]

WAR DEPARTMENT, June 21, 1889.

Respectfully returned to the Chief of Engineers, with the approval of the Secretary of War to the harbor lines as noted on the accompanying tracing.

By order of the Secretary of War.

JOHN TWEEDALE,
Chief Clerk.



APPENDIX F.

IMPROVEMENT OF SHEEPSHEAD AND CANARSIE BAYS, AND SUMPAWANUS INLET, NEW YORK—OF ARTHUR KILL, NEW YORK AND NEW JERSEY—OF CHANNEL BETWEEN STATEN ISLAND AND NEW JERSEY—OF RIVERS IN NORTHERN NEW JERSEY, AND OF THE HARBOR OF KEYPORT.

REPORT OF CAPTAIN THOS. L. CASEY, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1889, WITH OTHER DOCUMENTS RELATING TO THE WORK.

IMPROVEMENTS.

- | | |
|--|-----------------------------------|
| 1. Sheepshead Bay, New York. | 6. Passaic River, New Jersey. |
| 2. Canarsie Bay, New York. | 7. Elizabeth River, New Jersey. |
| 3. Sumpawanus Inlet, New York. | 8. Rahway River, New Jersey. |
| 4. Arthur Kill, New York and New Jersey. | 9. Raritan River, New Jersey. |
| 5. Channel between Staten Island and New Jersey. | 10. South River, New Jersey. |
| | 11. Shrewsbury River, New Jersey. |
| | 12. Keyport Harbor, New Jersey. |

EXAMINATIONS AND SURVEY.

- | | |
|------------------------------------|-----------------------------------|
| 13. East Rockaway Creek, New York. | 14. Hackensack River, New Jersey. |
|------------------------------------|-----------------------------------|
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UNITED STATES ENGINEER OFFICE,
New York, July 9, 1889.

GENERAL: I have the honor to transmit herewith my annual report on the works of river and harbor improvements in my charge for the fiscal year ending June 30, 1889.

Of these works the following were in charge of Capt. George McC. Derby, Corps of Engineers, until December 6, 1888: Passaic, Elizabeth, Rahway, Raritan, South, and Shrewsbury rivers, New Jersey, and Keyport Harbor, New Jersey; and the following were in temporary charge of that officer until the same date: Channel between Staten Island and New Jersey, Canarsie and Sheepshead bays, New York, and Sumpawanus Inlet, New York.

The improvement of Arthur Kill, New York and New Jersey, was placed in my charge by verbal order of the Chief of Engineers, December 10, 1888.

Very respectfully, your obedient servant,

THOS. L. CASEY,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

F 1.

IMPROVEMENT OF SHEEPSHEAD BAY, NEW YORK.

Sheepshead Bay, Long Island, is a small tidal bay about 2 miles long, lying inside Coney Island, N. Y., and extending easterly from the village of Gravesend to Rockaway Inlet, into which it empties. Its width varies from 100 to 1,000 feet, and its depth from 0 to 10 feet at mean low water.

The natural entrance is subject to progressive changes of position due to the action of the waves on the sandy beaches.

The first survey of this bay was made in 1879 by General Newton, whose report dated February 7, 1879, may be found in the Annual Report of the Chief of Engineers for 1879, page 400, and a further history of the improvement relating especially to the cut connecting the bay with Dead Horse Inlet may be found in the same report for the year 1888, Part 1, Page 625.

A project for the expenditure of the \$5,000 appropriated by the act of August 15, 1886, and of the additional \$5,000 appropriated by the act of August 11, 1888, was submitted January 10, 1889. This project called for a channel 60 feet wide and 5½ feet deep at mean low water from the town of Sheepshead to within 1,080 feet of Dead Horse Inlet Cut, a distance of 5,350 feet.

The project was approved February 9, 1889, and the work advertised under date of February 12. The bids (abstract herewith) were opened March 21, and the lowest bid, that of Brainard Bros. at 39 cents per cubic yard, was recommended for acceptance on the ground that a bid of this figure had been previously approved by the Chief of Engineers. The recommendation was, however, not approved and orders were received from the Department to reject all the bids and re-advertise the work. This was accordingly done under date of April 11, 1889, the bids (abstract herewith) being opened on May 6. The lowest bidder was the firm of Brainard Bros. at 33 cents per cubic yard. It was recommended that this bid be rejected, and authority was at the same time requested to do the work by hired labor in open market, which recommendation and request were approved by the Department.

On June 3 two private bids were received simultaneously; one from M. H. Flannery, dated May 30, and the other from Morris F. Brainard, dated June 1, both agreeing to undertake the work for 25 cents per cubic yard. It was recommended that the bid of M. H. Flannery be accepted; the approval of the recommendation by the Department being dated June 12, 1889. Work was to be begun as soon as possible, but nothing had been done at the close of the fiscal year.

Sheepshead Bay is not a harbor in any sense of the word, and in all probability never will be. At present it is only used for pleasure boats of small draught belonging to Gravesend and the large hotels on Coney Island.

There appears, therefore, to be no necessity for further appropriation at present.

This work is in the collection district of New York, which is the nearest port of entry. Nearest light-house, Fort Tompkins Light; nearest fort, Fort Hamilton.

The amount of revenue collected at the port of New York during the year ending June 30, 1889, \$147,694,618.45.

The total amount expended to June 30, 1889, is \$16,904.85.

The expenditures during the fiscal year amount to \$1,022.41, as follows:

Cost of pro rata share of 1 tug-boat.....	\$585.00
Cost of examination made in 1889.....	217.50
Cost of administration.....	219.91
Total	1,022.41
Original estimate (1879).....	100,000.00
Revised estimate (1882).....	34,290.00
Amount appropriated.....	26,000.00
Amount expended.....	16,904.85

Money statement.

July 1, 1888, amount available	\$5,117.56
Amount appropriated by act of August 11, 1888	5,000.00
	10,117.56
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$1,022.41
July 1, 1889, outstanding liabilities.....	60.75
July 1, 1889, amount covered by existing contracts.....	8,000.00
	9,083.16
July 1, 1889, balance available	1,034.40
{ Amount (estimated) required for completion of existing project	8,200.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of bids for dredging the channel in Sheepshead Bay, New York, opened at the United States Engineer Office, Army Building, New York, N. Y., at 12 o'clock m., on March 21, under advertisement dated February 12, 1889.

No.	Name and address of bidder.	Name and residence of sureties.	Price bid per cubic yard measured in scows.	Total amount of bid.
			<i>Cents.</i>	
1	John H. O'Rourke, Brooklyn, N. Y..	Peter J. O'Rourke and Patrick Torney, Brooklyn, N. Y.	45	\$8,000
2	Henry DuBois' Sons, New York, N. Y.	Abraham Du Bois and James Du Bois, New York, N. Y.	42	8,000
3	M. H. Flannery, New York, N. Y....	David J. Connell and Wright Holcomb, New York, N. Y.	50	8,000
4	Brainard Bros., New York, N. Y....	Theodore Smith, Bogota, Bergen Company, N. J. and George W. Rogers, Elizabeth, N. J.	39	8,000

Amount available for dredging, \$8,000.

Abstract of bids for dredging channel in Sheepshead Bay, New York, opened at the United States Engineer Office, room 79 Army Building, New York, N. Y., at 12 o'clock m., on May 6, 1889, under advertisement dated April 11, 1889.

No.	Name and address of bidder.	Name and residence of sureties.	Price bid per cubic yard measured in scows.	Total amount of bid.
			<i>Cents.</i>	
1	Morris F. Brainard, Brooklyn, N. Y.	Henry Smith and George W. Rogers, Jersey City, N. J.	33	\$8,000
2	Charles Du Bois, New York, N. Y..	Henry E. Du Bois and Abraham Du Bois, New York, N. Y.	41	8,000

Amount available for dredging, \$8,000.

F 2.

IMPROVEMENT OF CANARSIE BAY, NEW YORK.

The first survey of this bay with a view to its improvement was made in 1879. The scheme of improvement involved a channel 6 feet deep at mean low water and 100 to 150 feet wide, extending from the shore at Canarsie Landing to the navigable channel in Jamaica Bay, a distance of about 3,500 feet. It was thought that the channel might be maintained by the construction of two pile-dikes forming a tidal reservoir. The estimated cost under this project was \$88,000.

The rise and fall of the tide is 4.7 feet and the minimum low-water depth at present existing in the channel is 5.9 feet.

A detailed history of the work will be found in the Annual Report of the Chief of Engineers for 1887, Part I, p. 637.

At present a portion, 1058 feet in length, of the north dike has been constructed, and in January, 1888, bids were invited by public advertisement for constructing 1,000 feet of the south dike, and a contract formed on February 25 of the same year with Stephen A. Kelly for the construction of 850 feet of this dike, at \$9.87 per linear foot, it being necessary to reduce the projected length to some extent in order to retain funds for the necessary dredging in the spring. Work was begun May 2, 1888, and was in progress at the close of the fiscal year (see Annual Report, 1888). The date of expiration of this contract was July 1, 1888, but it was subsequently extended to August 3, at which date the contract was closed, 820 feet of dike having been constructed. The extreme width of this dike is 5 feet and its height 2 feet above mean high water. The piles used in its construction are of oak, and at the last inspection, May, 1889, the structure was in fairly good condition.

A special agreement dated October 31, 1888, was made with Brainard Bros. for dredging a channel 100 feet wide and 6 feet deep at mean low water from Canarsie Landing to deep water of Jamaica Bay, the stipulated price being 22½ cents per cubic yard, scow measurement. Work was begun under this agreement November 20, 1888, and concluded February 27, 1889, the total number of cubic yards removed being 33,320. The resulting channel is 100 feet wide and 6 feet deep at mean low water between the points indicated above, except for a short distance where the width is but 50 feet. In addition to this a cut 100 feet in length 50 feet in width and 6 feet deep was made on the east side of the steam-boat landing at Canarsie for the convenience of the steam-boats in turning.

In the project submitted for the expenditure of the appropriation of \$10,000, made under the act of August 11, 1888, it was recommended that \$1,500 be expended in repairing the north dike. An examination of the channel and dike in the early part of April of this year shows that the channel has remained practically unchanged during the past winter and that \$400 or \$500 will place the dike in good order. It was therefore recommended that \$1,000 of the fund reserved for repairs and extension of the dike be expended in dredging a cut at the end of the wharf at Canarsie Landing and extending it through to the southwest to connect with the southwest channel. This recommendation, which was made at the earnest solicitation of the people of the town of Flatlands, was approved by the Department at Washington, April 10, 1889, but no work has yet been done.

The expenditures during the fiscal year ending June 30, 1889, amount to \$16,827.11, as follows:

Cost of constructing 820 feet of dike (contract February 25, 1888)	\$7,988.40
Cost of dredging 33,320 cubic yards, at 22½ cents	7,497.00
Cost of examination of dredged channel (1889)	186.00
Cost of inspection	747.87
Cost of administration	407.84

Total 16,827.11

Canarsie Landing, besides being the terminus of the Brooklyn, Rockaway Beach and Jamaica Bay Railroad, from which passengers are transhipped by steamer to Rockaway Beach, has a large fishing industry.

The dikes already constructed appear to maintain the channel, and until the effect of floating ice during a hard winter can be observed it is recommended that the extension of them be deferred.

It is thought that \$10,000 will be sufficient to complete the channel and repair the dikes, and an appropriation of this amount is therefore recommended.

The amount expended on this improvement to June 30, 1889, is \$41,390.74.

This work is in the collection district of New York, which is the nearest port of entry. Nearest light-house, Fort Tompkins Light. Nearest fort, Fort Hamilton.

The amount of revenue collected at the port of New York during the fiscal year ending June 30, 1889, \$147,694,618.45.

Original estimates	\$88,000.00
Amount appropriated	43,000.00
Amount expended	41,390.74

A statement of the commerce of Canarsie Bay will be found in the Annual Report of the Chief of Engineers for 1887, Part I, page 740.

Money statement.

July 1, 1888, amount available	\$46.87
Amount appropriated by act of August 11, 1888	10,000.00
	<hr/> 10,046.87

July 1, 1889, amount expended during fiscal year exclusive of liabilities outstanding July 1, 1888	\$8,437.61
July 1, 1889, outstanding liabilities	2.00
	<hr/> 8,439.61

July 1, 1889, balance available	1,607.26
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{ Amount (estimated) required for the completion of existing project	45,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867	

F 3.

IMPROVEMENT OF SUMPAWANUS INLET, NEW YORK.

Sumpawanus Inlet, known in the neighborhood and on the Coast Survey charts as Sampawams Creek, is a small creek on the south side of Long Island, emptying into the Great South Bay.

It lies about 36 miles east of New York City, 15 miles east of the western end of the Great South Bay, and nearly twice as far from its eastern end.

Fire Island Inlet, through which most of the waters of Great South Bay pass into the Atlantic Ocean, lies south-southeast of Sampawams Creek, distant about 6 miles in a direct line, but 11 miles by the channel.

The inlet is a tidal stream from 100 to 200 feet wide, running up to the town of Babylon, Long Island, which lies less than a mile north of the mouth. It is crossed here by a dam, which forms a reservoir for the fresh-water of a small creek, which supplies the town with water.

The mean rise and fall of the tides at the mouth of the inlet is only 1.3 feet, and the bottom of the bay and of the inlet is soft mud.

The first survey of Sampawams Creek of which we have any record was ordered by act of Congress, approved June 14, 1880, and was made during the fall of 1888, under the direction of General (then Colonel) John Newton, Corps of Engineers.

His report may be found in the Annual Report of the Chief of Engineers for 1881, Part I, page 54.

The project of improvement based upon this survey provided for dredging a channel 150 feet wide and 5 feet deep at mean low water from the 5-foot curve in the bay to the steam-boat dock at the mouth of the creek, a distance of about 1,500 feet, and thence 5 feet deep and 100 feet wide up the inlet to the town of Babylon, a distance of about 3,500 feet further. The estimated cost of making this improvement was \$23,115.

The mean range of tides at the mouth of the inlet being only 1.3 feet, there was practically no current swift enough to produce scour. The depth of water in the proposed channel at the time of the survey was from 1 to 3 feet in the creek and from 3 to 5 feet outside.

It was not believed that diking would assist in improving this entrance, and inquiry showed that the depth of water both outside and inside the inlet had materially diminished in late years.

The amount expended under the project to June 30, 1888, was \$6,928.12, giving a channel 75 feet wide and 5 feet deep from the steam-boat wharf, 750 feet below it, besides two cuts, each 25 feet wide, alongside the wharf.

Outside of the cuts so made and extending to the 5-foot curve in the bay a shoal was left on which the depth was only about $4\frac{1}{2}$ feet.

An examination made in 1886 showed that since the last dredging was done, in 1883, both the cut and the flat outside had shoaled from 6 inches to 1 foot, the depth in the cut being about 5 feet, while on the flat it was from 4 to $4\frac{1}{2}$ feet. This was to have been anticipated, as appears by the preliminary report made by General Newton. The 5-foot curve in the bay was 1,500 feet from the steam-boat wharf, but inside this curve, for about 750 feet toward the wharf, lay the flat.

The commerce of Sampawams Creek is essentially that of Babylon, a small town of from 3,000 to 5,000 inhabitants, 1 mile above the mouth of the creek, depending almost entirely upon the summer trade of the hotels and cottages along the north shore of Great South Bay and on Fire Island Beach.

The commerce of Babylon by water has been decreased, apparently because the Long Island Railroad has taken away the sea-going business. Babylon itself has improved, and has become a fashionable summer resort. At present its commerce by sea is carried on by three passenger steam-boats, drawing from 4 to 5 feet, running in summer to Fire Island Beach; three schooners, drawing from 5 to $5\frac{1}{2}$ feet, carrying brick, lime, lumber, and other heavy freight to Babylon the year round; 100 sloops and pleasure boats, drawing from 1 to 2 feet of water, taking out

sailing and fishing parties in summer, of which seven or eight remain in use during the winter, fishing and taking oysters and clams to Patchogue, Sayville, and New York.

The commerce of the creek, in my judgment, does not warrant the formation of a channel more than 5 feet deep from the 5-foot curve in the bay to the steam-boat wharf, for the convenience of the few steamers and schooners which make use of the creek.

It is stated that the shoals in the bay kill the sea so entirely that pleasure boats can now lie in the mouth of the creek in all weather.

So far as the extension of the improvement from the steam-boat dock up to the inlet is concerned, there appears to be no reason why the Government of the United States should undertake it.

The original estimate of the cost of the work was \$23,115. Seven thousand dollars have been appropriated.

Ten thousand dollars can be expended in giving a 5-foot channel out into the bay for the use of steam-boats, but I think that the work is more a matter of local than public interest.

This work is in the collection district of New York, which is the nearest port of entry. Nearest light-house, Fire Island Light. Nearest fort, Fort Hamilton.

The amount of revenue collected at the port of New York during the fiscal year ending June 30, 1889, \$147,694,618.45.

Original estimate	\$23, 115. 00
Amount appropriated	7, 000. 00
Amount expended	6, 982. 87

Money statement.

July 1, 1888, amount available	\$71. 88
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	54. 75
July 1, 1889, balance available	17. 13
<hr/>	
{ Amount (estimated) required for completion of existing project	16, 115. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

F 4.

IMPROVEMENT OF ARTHUR KILL, NEW YORK AND NEW JERSEY.

The act of August 11, 1888, making appropriations for rivers and harbors provides as follows:

Improving Arthur Kill between Staten Island Bridge and the New Jersey shore, New York and New Jersey, dredging and straightening channel near Staten Island Bridge and removing the point of land westerly of same, ten thousand dollars.

This appropriation was introduced by the Committee on Commerce of the Senate, the object being to cut off the point on the Staten Island shore a short distance south of the railroad bridge with the hope and expectation that the current on the flood would be directed more truly towards the eastern draw-span of the bridge.

A rough survey of the point in question was ordered by Department instructions dated August 16, 1888, with request that a report and sketch giving the curves and depth of water, the amount of the point that can be cut off for the sum appropriated, the present direction of the flood currents and the probable or possible effect the dredging in

question will have upon the set of the flood-tide between the point and bridge, be forwarded to the Department.

This report was submitted August 30, 1888, was approved by the Acting Secretary of War September 4, 1888, and the officer then in charge, Captain Derby, ordered to submit a project for the expenditure of the money and to take immediate steps towards acquiring title to the necessary land to carry the excavation back to the proposed bulkhead lines. This project was submitted October 11, 1888.

This report inclosed the deed of Jacob Hatfield and wife in consideration of \$1 for 1.29 acres of land for the improvement of Arthur Kill, New York and New Jersey, and if approved it was recommended that payment be made for it (\$69.50) without waiting to have the title searched. The report also stated that the ownership of the remaining .22 acre required was in dispute and that it might be necessary to condemn this portion of the land in question.

In compliance with Department letter November 23, 1887, a tracing showing the approved plans for the improvement of Arthur Kill was transmitted to the Department October 11, 1888.

Application for the services of the United States district attorney for the eastern district of New York, to prepare the necessary papers for the conveyance of the land, in accordance with General Order No. 47, Adjutant General's Office, 1881, was made to the Department under date of October 23, 1888, and telegraphic notification dated December 31, 1888, was received January 2, 1889, authorizing me to consult with United States District Attorney M. D. Wilber.

The matter was placed in the hands of Attorney Wilber January 2, 1889. No action having been taken by the district attorney a communication was forwarded to the Department under date of April 20, 1889, requesting that condemnation proceedings be instituted under provisions of the act of April 24, 1888, with a view to procuring the land in question at the rate of \$60 per acre.

The Secretary of War on April 2-, in a letter to the Attorney-General, requested that condemnation proceedings be instituted, and the United States district court thereupon appointed commissioners to ascertain the compensation to be made to the owners and persons interested.

The commissioners appointed were as follows: Noah Tebbets, of Kings County, Clarence T. Barrett, of Richmond County, and Henry T. Metcalf, of Richmond County.

No further action had been taken at the close of the fiscal year.

The expenditures during the fiscal year ending June 30, 1889, amount to \$974.35, as follows:

Cost of pro rata share of 1 tug-boat.....	\$585.00
Cost of administration.....	389.35

This work is in the collection district of New York, which is the nearest port of entry; nearest light-house, Bergen Point Light; nearest fort, Fort Tompkins.

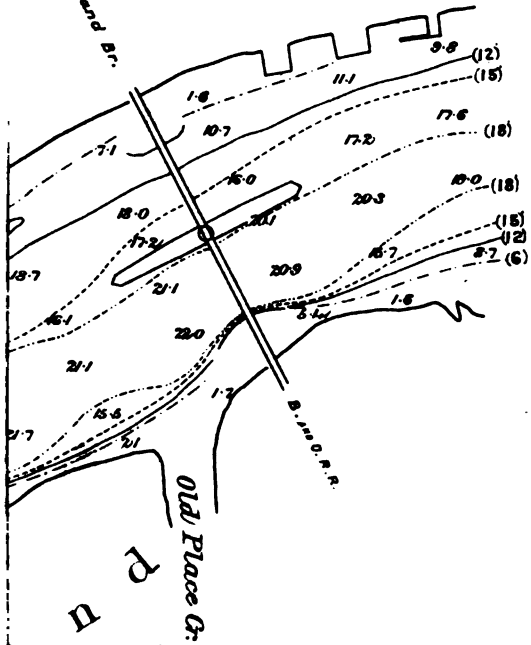
The amount of revenue collected at the port of New York during the year ending June 30, 1889, is \$147,694,618.45.

Money statement.

Amount appropriated by act August 11, 1888.....	\$10,000.00
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	974.35
July 1, 1889, balance available.....	9,025.65

{ Amount (estimated) required for completion of existing project.....	16,500.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	16,500.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Stearns Island Dr.



Capt. of Engrs. U.S.A.

F 5.

IMPROVEMENT OF CHANNEL BETWEEN STATEN ISLAND AND NEW JERSEY.

A description of this channel and a complete history of the work done towards its improvement may be found in the Annual Report of the Chief of Engineers for 1887, Part I, page 743.

Thus far the improvement has been confined to that part of the channel, about $1\frac{1}{2}$ miles long, which lies to the east of Elizabethport, N. J., and at the mouth of Newark Bay. This originally had a depth of only $9\frac{1}{2}$ feet at mean low water, while the remainder, lying between the shores of Staten Island and New Jersey, had a depth of from 14 to 40 feet at mean low water.

The first project for the improvement of this channel was made in 1873. This provided for dredging it to a depth of 16 feet for a width of 150 feet at its shallowest part, and protecting the cut by parallel dikes. The estimated cost of this was \$443,210. Fifty thousand dollars of this amount, appropriated in 1874, was spent in 1874-75 in the construction of 2,237 feet of the south dike, opposite Elizabethport.

Great opposition being made to this plan by oystermen and tow-boatmen, it was decided to modify it, and the project was therefore changed in 1880, so as to dredge a channel 400 feet wide and 13 feet deep over the middle 200 feet of its width, leaving it but 12 feet deep over the remaining widths of 100 feet on each side. The estimated cost of this work was \$125,705. In addition to this it was proposed, should it be found necessary, to build four detached dikes along the line of the channel, two on the north and two on the south side, the estimated cost of which was \$60,000, bringing the total estimated cost of the proposed improvement up to \$185,705.

No active work has been done during the past fiscal year, and the only expenditures have been for surveys, office administration, and part purchase of steam-propeller, amounting to \$2,123.33, as follows:

Cost of pro rata share of one tug-boat	\$910.00
Cost of survey (April, 1889)	501.00
Cost of draughting.....	148.00
Cost of administration	564.33
Total.....	2,123.33

In its present condition the channel possesses depths of from 13 to 20.7 feet at mean low water throughout its length, through widths varying from 160 to 350 feet, the narrowest portion being in the bend at the Stake Light, where it appears to be least stable.

Before proceeding with the expenditure of the \$15,000 appropriated by the act of August 11, 1888, it was considered desirable to settle, if possible, the question of training-dikes, and in this connection the following letter was addressed to the Chief of Engineers on May 9, and the reader is referred to the accompanying diagram as explanatory of the subject-matter of the letter:

NEW YORK, May 9, 1889.

GENERAL: In compliance with your letter of August 22, 1888, I have the honor to submit the following project for the expenditure of the appropriation of \$15,000 in the act of August 11, 1888, for continuing the improvement of the channel between Staten Island and the New Jersey shore, New York and New Jersey.

The project now in process of execution consists in making a channel, connecting Arthur Kill with Kill-von-Kull, 5,900 feet long, 400 feet wide, 100 feet on either side of the axial line to have 13 feet depth mean low water, and the residue only 12 feet, with training-dikes on both sides, if the channel can not otherwise be maintained.

The current observations, made in 1872, under the direction of General Newton, indicated a complexity of condition which, if true, would render the proper course to take in the improvement of this channel a matter of some doubt. I have accordingly had a new series of observations made by Mr. C. S. Kelsey, the results of which it is proposed to discuss before recommending any active work. The results obtained by Mr. Kelsey, while practically corroborating the earlier ones of General Newton, give some interesting additional information. On the diagrams transmitted herewith the flood currents are given in their earlier, middle, and later stages on map A, while the corresponding stages of the ebb are represented on map B.

On examining the earliest Coast Survey charts of this region, it is seen that a very good natural channel has always existed in nearly its present position, showing that, although a meeting point of the floods through the Arthur Kill and Kill-von-Kull, and therefore an elevated region of slackwater near the flood stages, there must, nevertheless, be an eroding current at certain stages of the tide. This premise is confirmed by the current observations. It is seen that the portions which follow the channel, and therefore those to which it owes its existence, are the early flood and the last of the ebb. After the early flood has passed, the currents simply flow in a broadly divergent, somewhat indefinite, area to the north, because of the dynamic head caused by the opposed currents behind. They do not appear to take any definite channel, but flow northward across the angular portion of the present channel.

From a mature study of these conditions it would appear that no dikes can be of sufficient service to warrant their cost. The course of the present channel is determined by conditions which could not be materially modified by diking. The western portion is simply a direct prolongation of the narrow, deep channel through the Arthur Kill, and the eastern portion a correspondingly direct prolongation of the Kill-von-Kull, the northwesterly deflection of the eastern portion after passing between Shooter's Island and the mainland being caused by the point of land opposite Shooter's Island. These currents meet at the present angle of the channel and, as before stated, move off in the flood stages in a broad area to the northward. The angle in question (at the Stake Light) must always be a point subject to deposition, and the only course to pursue will be to dredge it from time to time to the requisite depth.

I would, therefore, recommend that the present project, involving diking, be so modified as to dispense with the dikes, and that the entire available funds be devoted to dredging at the positions marked on the map transmitted to the Department January 18, 1889, the work to be done by contract after the specifications are prepared and advertisement for proposals made in the usual manner in the public press.

The available funds may be advantageously expended as follows:

For dredging	\$13,500.00
For administration, inspection, and surveying.....	1,500.00
Total	15,000.00

Very respectfully, your obedient servant,

THOS. L. CASEY,
Captain of Engineers.

The CHIEF of ENGINEERS, U. S. A.

Through General H. L. Abbot, Corps of Engineers, Division Engineer N. E. Division.

WASHINGTON, D. C., May 15, 1889.

CAPTAIN: Your letter of 9th instant submitting project for the expenditure of the appropriation of \$15,000 made by the river and harbor act of August 11, 1888, for channel between Staten Island and the New Jersey shore, has been received.

The project is approved, the work to be done by contract after advertisement in accordance with regulations.

By command of Brig. Gen. Casey.

Very respectfully, your obedient servant,

H. M. ADAMS,
Major, Corps of Engineers.

Through Col. H. L. Abbot, Corps of Engineers, Division Engineer, N. E. Division.

In accordance with this plan specifications were prepared based on a survey made during the month of April, 1889; these were duly advertised and the bids opened on June 24, 1889 (abstract herewith).

IMPROVEMENT OF
BETWEEN STATEN I.D. AND NEW JERSEY
IN CHARGE OF
THOS. L. CASEY, CORPS of ENGRS. U.S.A.

36 pm.

Current Observations
during
FLOOD TIDE
made
April 1889.

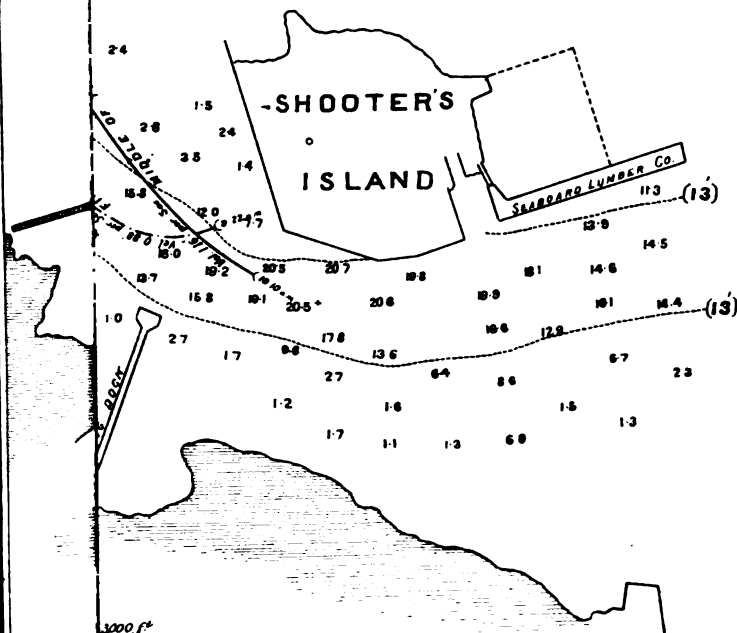
18 → 11 26 a

Note: - Only characteristic threads showing
the trend of the Current during the
First, Middle & Last stages of the tide
are shown.

Respectfully submitted:

Thos. L. Casey
Capt. of Engrs U. S. A.

April 18 → 11 37 a





IMPROVEMENT OF L BETWEEN STATEN I.D. AND NEW JERSEY

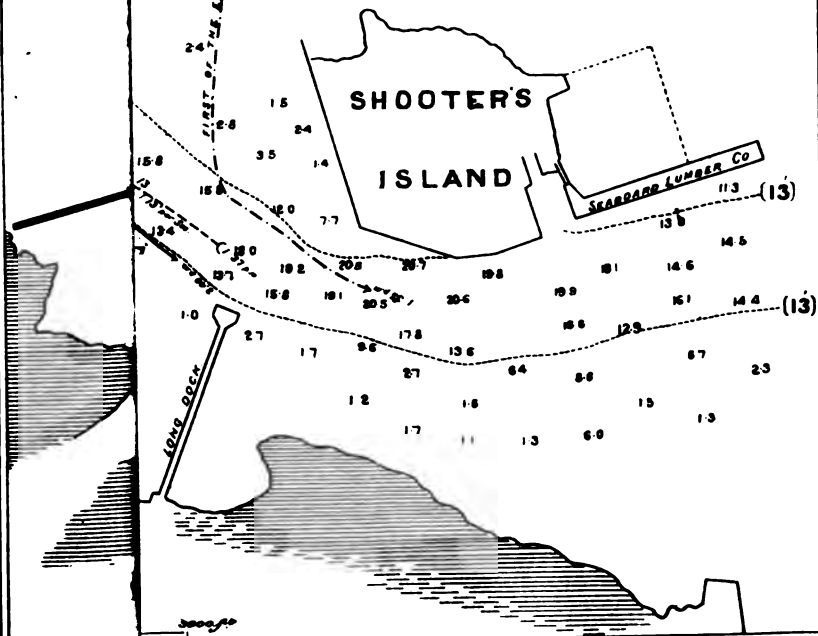
T. THOS. L CASEY, CORPS OF ENGRS. U.S.A

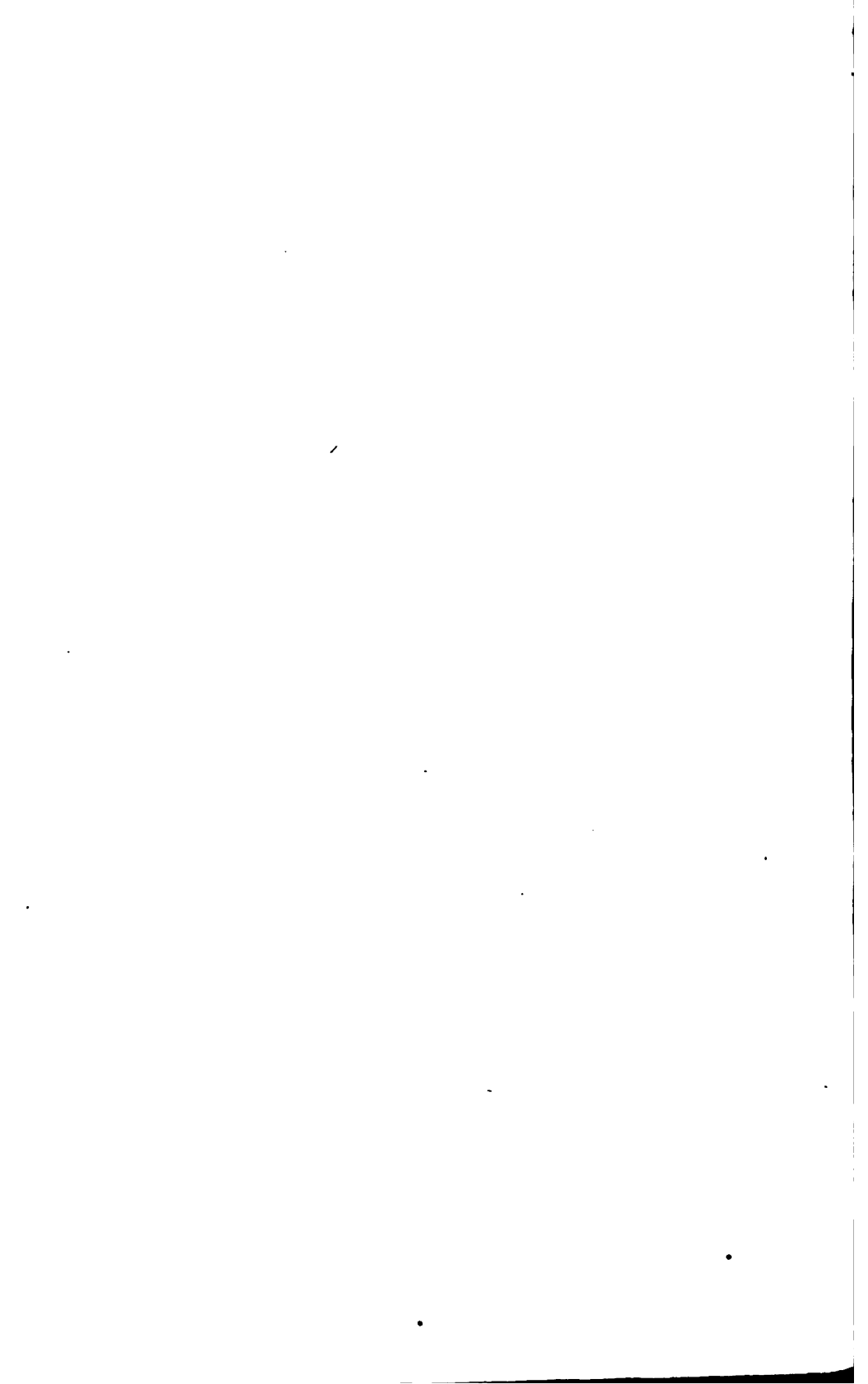
Current Observations
during
EBB TIDE
made
April 1889.

NOTE - Only characteristic threads showing the trend of the Current during the First Middle & Last stages of the tide are shown.

Respectfully submitted

Capt. of Eng'rs U.S.A.





The commerce of this channel, which is known as the Kills, is so large that the narrow, abrupt bend near the Stake Light constitutes a serious impediment to navigation. This part should be widened to 400 feet as proposed, the depth of the widened part to be 13 feet as in the other portions of the channel, and it is recommended that \$30,000 be appropriated for this purpose.

From statistics compiled in the fiscal year ending June 30, 1887, the total shipping passing the Stake Light was shown to be 8,442,439 tons with a valuation of \$67,539,512.

This work is in the collection district of New York, which is the nearest port of entry. Nearest light-house, Bergen Point Light; nearest fort, Fort Tompkins.

The amount expended to June 30, 1889, was \$170,312.73.

The amount of revenue collected at the port of New York during the fiscal year ending June 30, 1889, \$147,694,618.45.

Original estimate (1873).....	\$443,210.00
Revised estimate (1880).....	185,705.00
Revised estimate (1883).....	210,000.00
Amount appropriated.....	184,000.00
Amount expended.....	170,312.73

Money statement.

July 1, 1888, amount available.....	\$810.60
Amount appropriated by act of August 11, 1888.....	15,000.00
	<hr/> 15,810.60
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	\$2,123.33
July 1, 1889, outstanding liabilities.....	74.62
July 1, 1889, amount covered by existing contracts.....	12,000.00
	<hr/> 14,197.95
July 1, 1889, balance available.....	<hr/> 1,612.65
{ Amount (estimated) required for completion of existing project.....	76,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	30,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstracts of bids for improving the channel between Staten Island and New Jersey, by dredging, opened at the U. S. Engineer Office, room 79, Army Building, New York, N. Y., at 12 o'clock m, on June 24, 1889, under advertisement dated May 24, 1889.

No.	Name and address of bidder.	Name and address of sureties.	Per cubic yard measured in scoops.	Total amount of bid.
1	Thomas H. Benton, Elizabeth, N. J.	Geo. W. Rogers and Kendrick R. Wilson, Elizabeth, N. J.	Cents. 27	\$12,000

Amount available for dredging, \$12,000.

The bid of Thomas H. Benton was accepted by the Department June 28, 1889, and a contract for doing the work will be entered into as soon as practicable.

F 6.

IMPROVEMENT OF PASSIAC RIVER, NEW JERSEY.

The Passaic River is being improved under two separate projects, the first applying to the river above Centre Street Bridge, Newark, as far as Passaic, a distance of 8 miles; the second to the lower course of the river, from Centre Street Bridge to and beyond the shoal in Newark Bay, a distance of 7½ miles.

1.—ABOVE NEWARK.

Before its improvement was undertaken the upper part of the river had a navigable 6-foot channel, except at Middle, Belleville, Rutherford, Park, and Holzman's bars, where the depths were 4.5 feet, 3.9 feet, 3 feet, and 3.5 feet, respectively.

The project of improvement was adopted in 1872, and provided for a channel across and above the shoals from 7½ to 6 feet deep at mean low water, and from 200 to 50 feet wide, to be obtained by dredging and diking, at a cost of \$123,924. It was modified in 1885 by extending the channel below Middle Bar 1,500 feet to the Erie Railroad Bridge, increasing the estimate to \$129,000.

Under this project \$124,107.54 had been expended to June 30, 1888, and channels of the requisite depth had been dredged from 60 to 75 feet wide, excepting for a distance of 1,500 feet above the Erie Railroad Bridge.

No work has been done during the fiscal year, and no expenditure of money excepting for office administration, and a pro rata payment for the dredging plant, described under the head of the Raritan River, amounting to \$3,708.92, as follows:

Cost of pro rata share of one dipper-dredge	\$1,629.00
Cost of pro rata share of three dump-scows	1,235.25
Cost of pro rata share of one tug-boat	390.00
Cost of inspection	240.00
Cost of administration	214.67
Total	3,708.92

The channel is comparatively free from rapid changes, and no complaints have been received during the year. The traffic on the river is steadily increasing, 10,773 vessels passing the draw-bridge at Centre street, Newark, during the past year, against 10,040 in 1887, and 6,271 in 1879.

On the 22d of December, 1888, a letter was written by Mr. William O. McDowell to the Hon. C. S. Fairchild, Secretary of the Treasury, stating that the bridge of the New York and Greenwood Lake Railroad, in North Newark, was injuring navigation by reason of the large stones forming the filling of the ice-breakers of the draw-support falling into the fair-way of the draw, the sheathing having become insecure from decay. On investigation it was found that no serious damage had been done, but it was recommended that the railroad company be requested to repair the sheathing.

With the exception of a survey made in 1879 from Centre Street Bridge to Montclair and the Greenwood Lake Railroad Bridge, a distance of 2½ miles, no detailed survey of any portion of the upper river has been made since 1875, and, from the records, no complete survey has ever been made. It is therefore proposed to begin a complete and

systematic survey as soon as practicable, and before resuming active operations.

The estimated amount required to complete the existing project is \$7,512, and of the survey \$1,500.

Passaic River is in the collection district of Newark, which is the nearest port of entry. Nearest light-house, Passaic Light, at the lower end of dike in Newark Bay. Fort Tomkins is the nearest fort.

Amount of revenue collected during the fiscal year ending June 30, 1889, \$2,018.07.

Original estimate (1872).....	\$123,924.00
Revised estimate (1886).....	133,762.00
Amount appropriated.....	133,750.00
Amount expended.....	127,816.46

Money statement.

July 1, 1888, amount available.....	\$2,142.46
Amount appropriated by act of August 11, 1888.....	7,500.00
	<hr/>
	9,642.46
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	3,708.92
	<hr/>
July 1, 1889, balance available.....	5,933.54
	<hr/>
{ Amount (estimated) required for completion of existing project.....	3,100.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	9,012.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

2.—BELOW NEWARK.

The lower portion of the river, from the Centre Street Bridge to Newark Bay, was first surveyed by the Engineer Department in 1879. The greatest depth in the channel at a point above the Elbow Beacon was only 7.1 feet, and in many places the greatest depth was 7 5 feet at mean low water. A project was adopted, based on this survey, providing for obtaining, by diking and dredging, a channel 200 feet wide and 10 feet deep at mean low water, from the Centre Street Bridge to Newark Bay, at a cost of \$232,875.

This project was modified in 1884, pursuant to the river and harbor act of that year, providing for extending the dike at the mouth of the river into the bay, a distance of 12,000 feet, and for dredging a channel across the shoal in Newark Bay, 200 feet wide and 10 feet deep at mean low water, increasing the original estimate to \$353,875.

June 30, 1888, \$168,707.85 had been expended under this project; the dike at the mouth had been extended about 2,200 feet, making a total length of 6,205 feet; the channel through the shoal in the bay had been dredged to the required dimensions, as also the channel up the river as far as the Newark and New York Railroad Bridge. The remainder of the distance to the Centre Street Bridge the 10-foot channel had only been dredged from 130 to 100 feet in width. These results had been of very great benefit to the large commerce of the river, which was estimated in 1884 at 1,200,000 tons, valued at \$30,000,000.

The contract of October 25, 1886, with P. Sanford Ross, for the construction of about 1,500 feet of dike, in prolongation of the dike at the mouth of the river, had been extended 90 days at the close of the fiscal year ending June 30, 1887. The contractor continued work until September 7, 1887, when the contract was closed; 500.3 feet of dike were constructed during that fiscal year, making the total length con-

structed under the contract 1,500.3 feet, and the entire length of the dike 6,205; its projected length is 12,000 feet.

The statement made in the preceding paragraph represents the condition of the dike at the present day, no additional work having been done.

With the exception of a very slight amount of shoaling near the mouth of the river (about 0.5 of a foot), the channel is maintaining itself, and no complaints have been received during the year.

For reasons advanced by my predecessor in the annual report for 1888, it is not advisable to make any further expenditures in extending this dike until such extension is shown to be necessary.

The expenditures for the fiscal year amount to \$12,429.99, as follows:

Cost of pro rata share of 1 dipper-dredge.....	\$5,973.00
Cost of pro rata share of 3 dump-scows.....	4,529.25
Cost of pro rata share of 1 tug-boat.....	1,300.00
Cost of inspection of same.....	176.67
Cost of administration.....	451.07
Total.....	12,429.99

The estimated amount required for the completion of the existing project is \$154,375, and of this it is estimated that \$100,000 might profitably be expended during the fiscal year ending June 30, 1891, in widening the channel to the dimensions required by the existing project and in the construction of the river dikes.

Passaic River is in the collection district of Newark, which is the nearest port of entry. Nearest light-house, Passaic Light, at the lower end of the dike in Newark Bay. Fort Tompkins is the nearest fort.

Amount of revenue collected during the fiscal year ending June 30, 1889, \$2,018.07.

Original estimate (1879).....	\$232,875.00
Revised estimate (1884).....	353,875.00
Amount appropriated.....	199,500.00
Amount expended.....	181,137.84

Mr. George B. Swain, chairman of the Board of Trade, Newark, reports that no marked change has been observed in the tonnage of the Passaic for the past year. It is estimated at 1,000,000 tons annually. Twenty-two thousand three hundred and seventeen vessels passed the draw at the mouth of the river as against 22,742 in 1887.

Money statement..

July 1, 1888, amount available.....	\$3,113.15
Amount appropriated by act of August 11, 1888.....	27,500.00
	<hr/> 30,613.15
July 1, 1889, amount expended during fiscal year, exclusive of	
liabilities outstanding July 1, 1888.....	\$12,250.99
July 1, 1889, outstanding liabilities.....	92.63
	<hr/> 12,343.62
July 1, 1889, balance available	18,269.53
	<hr/>
{ Amount (estimated) required for completion of existing project.....	154,375.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	100,000.00
{ Submitted in compliance with requirements of sections 2 of river and	
harbor acts of 1866 and 1867.	

F 7.

IMPROVEMENT OF ELIZABETH RIVER, NEW JERSEY.

This stream, which is 2½ miles in length from its mouth to the head of navigation, at Broad street, Elizabeth, has a width of from 50 to 90 feet, and before its improvement the wharves in the city could only be reached at high water by vessels drawing less than 4 feet. Its commerce was estimated at 45,000 tons annually. The range of the tide was about 4.7 feet at its mouth and 3.4 feet at Bridge street.

The project for the improvement was adopted in 1878, and provides for obtaining by dredging a channel 60 feet wide and 7 feet deep at high water from the mouth of the river to the head of navigation, at an estimated cost of \$25,530.

The amount expended under this project to June 30, 1888, was \$26,721.74 and a channel has been dredged to the required depth to within 1,000 feet of the Broad Street Bridge. A slight increase in the commerce of the stream had been observed.

There has been no appropriation for this work since 1882, and the expenditures during the last fiscal year have been \$179.11 for office expenses.

The condition of the river has deteriorated since work was suspended. When last examined vessels drawing 5 feet could ascend the river to the head of the dredged channel at high tide. The commerce of the river is about 30,000 tons, but no substantial increase can be expected while the river remains in its present condition. A coal-yard established last year has done a business of about 6,000 tons.

If it is the intention of Congress to complete this improvement the balance of the estimate, \$16,160, could be expended profitably as regards the efficient prosecution of the work during the fiscal year ending June 30, 1891, and would be applied to dredging the channel to the full dimensions required by the project.

The estimated amount required for the completion of the improvement is \$16,160.

Elizabeth is in the collection district of Newark, N. J. Nearest light-house, Bergen Point Light. Nearest fort, Fort Tompkins.

Amount of revenue collected at the port of Newark, N. J., during the fiscal year ending June 30, 1889, \$2,018.07.

Original estimate (1878).....	\$25,530.00
Revised estimate (1882).....	43,160.00
Amount appropriated	27,000.00
Amount expended.....	26,900.85

Money statement.

July 1, 1888, amount available	\$278.26
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$179.11
July 1, 1889, outstanding liabilities.....	23.40
	<hr/>
	202.51
July 1, 1889, balance available	<hr/>
	75.75

{ Amount (estimated) required for completion of existing project	16,160.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	16,160.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

F 8.

IMPROVEMENT OF RAHWAY RIVER, NEW JERSEY.

In its original condition the Rahway River had a depth of 8 feet and more at mean high water from its mouth to Bricktown, $3\frac{1}{2}$ miles; 7 feet at Edgar's Dock, $4\frac{1}{2}$ miles; 4.4 feet to Milton Avenue Bridge, $4\frac{1}{2}$ miles, and 4 feet to Main Street Bridge, 5 miles, in the town of Rahway. Its commerce was estimated at 120,000 tons, and three attempts had been made to establish a line of steam-boats on the river, but had failed on account of the bad condition of the stream.

The original project for its improvement was adopted in 1878, and provided for dredging a channel 125 feet wide and 8 feet deep at high water from Bricktown to Milton Avenue Bridge, and 100 feet wide from that point to Main Street Bridge. The tide rises about 5 feet at the mouth and 4 feet at the head of navigation.

June 30, 1888, \$36,932.33 had been expended under this project, which had resulted in the formation of a channel 7 feet deep at high water, and from 100 to 50 feet in width to within 550 feet of the head of navigation. It has not, however, proved permanent.

The commerce of the river had not increased, though freight rates to Rahway had been materially reduced as a result of the improvement of the river.

There has been no appropriation for this work since 1882, and the expenditures for the last fiscal year amounted to \$60.37 for office expenses.

The condition of the river has deteriorated since work was suspended and its commerce has decreased, the shoaling of the river having obliged one of the principal shippers to transfer his business to the railroad.

If it is the intention of Congress to complete this improvement, the balance of the estimate, \$29,250, could be expended profitably as regards the efficient prosecution of the work during the fiscal year ending June 30, 1891, and would be applied to deepening and widening the channel by dredging.

The estimated amount required for the completion of the improvement, in accordance with the approved project, is \$29,250.

This work is in the collection district of Perth Amboy, N. J., which is the nearest port of entry. The nearest light-house is Prince's Bay Light, and Fort Tompkins is the nearest fort.

Amount of revenue collected during the fiscal year ending June 30, 1889, \$59,632.83	
Original estimate (1878).....	\$36,653.00
Revised estimate (1882).....	66,250.00
Amount appropriated.....	37,000.00
Amount expended.....	36,992.70

Money statement.

July 1, 1888, amount available.....	\$67.67
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888.....	60.37
July 1, 1889, balance available.....	7.30

{ Amount (estimated) required for completion of existing project.....	\$29,250.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	29,250.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

F 9.

IMPROVEMENT OF RARITAN RIVER, NEW JERSEY.

Before its improvement by the United States the Raritan River had a depth of 8.5 feet at "The Stakes," 3 miles; of 6.5 feet at the "Middle Grounds," 4½ miles; of 7.5 feet at Whitehead's Sand Dock, 8½ miles; and between this point and New Brunswick, 12½ miles above the mouth, the channel was obstructed by a number of rocky shoals with depths of from 8.4 feet to 6.9 feet at mean low water. The city of New Brunswick and the Delaware and Raritan Canal which terminates here, together with extensive brick-yards on the South River, did a large commerce on the stream, estimated in 1871 at 3,053,857 tons per annum.

The present project was adopted in 1874, and provides for obtaining by diking and dredging and, where necessary, by drilling and blasting rock, a channel 200 feet wide and 10 feet deep at mean low water from the mouth to New Brunswick, at a cost of \$2,093,662.05. It was modified in 1881, pursuant to the river and harbor act of that year, by adding to it the dredging of the south channel, about 13,000 feet long, 100 feet wide, and 5½ feet deep at mean low water, from Kearney's Dock to Crab Island.

Under this project \$456,674.58 had been expended June 30, 1888, in constructing the dikes required by the project at "The Stakes" and "Middle Grounds," in dredging channels 200 feet wide and 12 feet deep at mean low water at these points, and in drilling, blasting, and dredging a channel of the same dimensions across the rocky shoals at Whitehead's Sand Dock. Under the two special allotments made for it in the acts of March 3, 1881, and August 2, 1882, the south channel was dredged to the required depth for a distance of 4,000 feet. These improvements had been of great benefit to navigation, permitting the large tows in use on the river to reach a point 4 miles below New Brunswick at all stages of the tide. The commerce of the river was reported in 1887 at 1,675,355 tons, valued at \$28,119,173.

A special agreement approved June 13, 1888, was made with M. H. Flannery for dredging a channel through the shoals between Whitehead's Sand Dock and Martin's Dock, at 40 cents per cubic yard, and for the construction of a lateral training-dike with the dredged material. According to the modified project, the proposed dike was to be 3,260 feet in length with a width of 25 feet and built to the height of mean low water.

On July 16, 1888, work was commenced on the shoal below Martin's Creek at the point where the operations of the preceding season had been discontinued and completed August 6, 3,263 cubic yards having been excavated. The completed channel is 900 feet in length, 100 feet wide, and 10 feet deep at mean low water, and the total amount of material removed, 10,893 cubic yards.

Work was begun on the shoal below Widmar's Dock on August 6, and the channel, 1,080 feet in length, and of the same width and depth as the preceding, completed September 18. The amount of material removed was 10,474 cubic yards.

Operations were begun on the third shoal opposite Martin's Dock on September 22, and discontinued on November 19, the material removed amounting to 11,516 cubic yards, the resulting channel, 100 feet wide and 10 feet deep, being 1,040 feet in length.

At the conclusion of the working season the channel had been carried 1½ miles up the river and to within 1½ miles of New Brunswick.

The amount of dredged material used in constructing Dike C, mentioned above, was 25,084 cubic yards, and 840 cubic yards of riprap was used in revetting the face and top of the first 600 feet, at a cost of \$1,050, purchased in open market. The remaining part of the dike is not revetted, and is only partially completed, and at the close of the last season showed marked deterioration, as the following report of Mr. C. S. Kelsey, founded on recent observation, will fully show:

NEW YORK, June 24, 1889.

CAPTAIN: I have the honor to submit the following report on the examination of Dike C, Raritan River, made in pursuance of your order of June 14, 1889.

An examination was made in December, 1888, to determine the effect upon the channel in this vicinity, caused by partial construction of Dike C. The recent examination was devoted mainly to the condition of the dike itself.

The examination of December showed a deterioration in the channel from abreast the dike for 2,000 feet down the river.

The decrease in depth was about 1 foot, which was sufficient to narrow up materially, and over part of the distance to obliterate, the 10-foot channel. The unfinished portion of the dike had at that time wasted or spread out to something like the former level, save in detached lumps.

The recent examination shows little or no change since December in the vicinity of the dike, or in the unfinished portion. The first 600 feet, considered as completed, has been wasting away, notwithstanding the stone revetment. There is now only 50 feet, linear, standing up to mean low water, the balance having settled from 1 to 2 feet. This wasting is due to the high waters, which rise above the top level and wash across the dike, sifting out the sand from beneath the light paving.

The experiment of last season demonstrates several points: That, in advancing, the dike must be built out from the meadow bank as nearly solid as possible; that the height, when finished, should exceed mean low water by enough to prevent any tides from washing across the section; that the dike should be built to completion in as short lengths as practical; and that care should be taken in rehandling to dredge in front of the dike to no greater depth than the original bottom, lest a secondary channel be created by the increased action of the currents along the face.

I would recommend as of the utmost importance, before continuing the construction of the dike, that the paved portion be first built up with riprap to 1 foot above mean high water to cut off the cross-currents, and that hereafter the dike be built to 1 foot above mean high water. It is expected that the material from above Martin's Dock will run coarser than that dredged last season; otherwise there is bound to be some wasting at the dike, due to dumping and rehandling.

Whether the cost of repairing the injury to the channel in the vicinity of the dike is the cheapest method of disposing of the dredgings is an open question.

It would seem advisable to give the plan at least another season's trial.

Respectfully submitted,

C. S. KELSEY,
Surveyor.

Capt. THOS. L. CASEY,
Corps of Engineers, U. S. A.

On November 10, 1888, Captain Derby was authorized by Department letter to dredge a channel 50 feet wide and 6 feet deep at mean low water from the river at the dikes to Acken's Dock. Under a special agreement with M. H. Flannery, at 15 cents per cubic yard, work was commenced on November 20, 1888, and the improvement completed November 29, 4,123 cubic yards having been removed. This carried the channel, with the indicated width and depth, from the river to the wharf, a distance of 575 feet.

Owing to the tendency of this channel to fill up it is necessary to dredge it every five or six years, and for this reason Captain Derby considered it desirable to come to some final agreement with the company owning the wharf, so that this continued expenditure might be avoided. The result of this correspondence is shown in the following letter:

OFFICE NEW JERSEY FIRE CLAY AND BRICK COMPANY,
New York, October 10, 1889.

DEAR SIR: In reply to your letter of the 5th instant, will say: This company will make the following proposition as a final settlement of the matter of the shoaling at

its dock on the Raritan River, viz: In consideration of a sum of \$1,500 paid to this company, a license to extend its dock to the dike, and to use 400 feet of the dike for a dock, it will agree to waive all claims for loss or damage by low water in the past or future, the matter of the channel for the creek mentioned in previous letter to be provided for by the Government at its pleasure.

Yours very truly,

CLEMENT PARSONS, JR.,
President.

GEO. MCC. DERBY,
Captain of Engineers, U. S. A.

The total expenditure by the Government in its successive dredgings of this channel is \$2,334.45. It therefore appears desirable that an agreement similar to that suggested in the above letter should be made as soon as possible. The use of 400 feet of the dike by the company as a dock would be effective at least in keeping this portion of the dike in good condition.

A combination having been formed by the dredge owners in this vicinity, it was thought by my predecessor, Captain Derby, that if the United States Government should own its dredging plant a considerable economy in the operations of this district could be effected. The matter was laid before the Department at Washington, and the latter, concurring in the views of Captain Derby, finally authorized the building of a dredging outfit. It was considered that it would be most economical and advantageous for the Government to have the dredge built by private agreement, and, after due inquiry, the Osgood Dredge Company, of Albany, N. Y., was selected as the best firm to do the work. Detailed specifications were accordingly submitted by the Osgood Dredge Company, and these had just been ratified by the representatives of the company and Captain Derby, when I relieved the latter from charge of the district. Work was begun on the dredge early in January, 1889, and the latter delivered in New York fully completed and equipped on the 13th of May.

The following are some of the more important details concerning this dredge, the operations of which to the close of the fiscal year are recorded under the head of the Shrewsbury River, New Jersey:

Hull, 80 by 30 by 8 feet. Material yellow pine, with the exception of the A-frame, spuds, and dipper-handle, which are of white oak. The sides trussed; bolts, $1\frac{1}{2}$ inch in diameter. The fore and aft keelsons, 40 in number, are 8 by 12 inches; the cross-keelsons, 8 in number, 10 by 12 and 8 by 12 inches. There is an 8-inch breast knee at each corner of the bow, top and bottom, and a 6-inch knee at forward end of each fore and aft keelson and at each end of the cross-keelsons. The spud-wells are of well-seasoned timber, rabbeted, tongued, and grooved, closely fitted and bolted together with 1-inch bolts. Four $1\frac{1}{2}$ -inch rods extend through the boat from side to side at the spud-wells. The bottom planking extends across the boat without break and is 3 inches in thickness.

The main engine has a 12 by 18 inch double cylinder with plain slide-valves, and there are two friction drums operated by hydraulic band frictions. All shafts are of hammered steel. The crank-shaft bearings are of extra heavy composition. The hoisting pinion is of gun metal. Hoisting drum, 20 inches in diameter.

The swinging engine has a 7 by 10 inch double cylinder, with link motion. All shafts are of steel, bearings "babbitted."

The boiler is locomotive; the shell 56 inches in diameter, 16 feet 5 inches long, the furnace 56 by 50 inches, the water-space 3 inches, the dome 30 by 30 inches. Flue-heads and dome-head three-eighths inch; all other sheets five-sixteenths inch in thickness, all tested and stamped 50,000, T. S.

The fixtures include two safety-valves, three gauge-cocks, water-glass, steam-gauge, whistle, blow-off-cocks, grate-bars, wrought-iron ash-pan, and fire tools. There is also an injector and an independent feed-pump.

The turn-table is 12 feet in diameter. The boom is of angle iron and is 35 feet in length from center of hinge-pins to center of sheaves. The sheaves are 30 inches in diameter. The dipper will hold 2 cubic yards, struck measurement. It has double doors, the upper door swinging both ways, so as to allow the dipper to fill with water

from the bottom while being lowered. About 18 inches of hoist is saved by this method of hanging the doors. The A-frame is constructed of four 7 by 14 inch sticks, the center of the collar at the top standing 50 feet above the deck. The capacity of this dredge is 1,500 cubic yards per day of ten hours in soft material.

During the month of April, 1889, specifications for the construction of three dump-scows, each of 200 cubic yards capacity, were drawn up and the work advertised in the usual manner. The resulting bids, an abstract of which is given below, were opened March 21 and the contract awarded J. D. Leary, of Brooklyn, N. Y. The scows were completed and delivered in accordance with the terms of the contract on June 7.

These scows were designed to dump in very shallow water, and are of unusual form, being very long and wide in proportion to their draught, which, when loaded, is but $5\frac{1}{2}$ feet. They have a very rigid compound longitudinal keelson along the middle with two series of double-bottom gates, this form of construction being rendered necessary by the great width and slight depth, which would give the sides of the bins too gentle a slope to properly shed the material, if a single series of bottom outlets only were provided.

In actual use the scows have thus far proved perfectly satisfactory, but from their great superficial area are rather cumbersome, and the steam-tug *Star*, carried on the property rolls of this district, which it was thought would prove efficient, was soon seen to have too little power to handle them properly in the rapid currents of the tidal streams where the improvements are progressing. Permission was therefore obtained to purchase a tug in open market, at a cost of \$6,500, and, after a somewhat prolonged search, a very staunch, new, and powerful boat was obtained, which has rendered it possible to make full use of the scows.

In December, 1888, an examination was made at the dredged channels through the shoals described above, and on May 24, 1889, a new detailed survey was begun on that portion of the river from Martin's Dock to the city of New Brunswick. This survey, which is intended to furnish data for the improvement of this part of the river, is still unfinished.

The expenditures during the fiscal year ending June 30, 1889, amount to \$35,858.22, as follows:

Cost of pro rata share of 1 dipper-dredge.....	\$10,860.00
Cost of pro rata share of 3 dump-scows.....	8,235.00
Cost of pro rata share of 1 tug-boat.....	1,950.00
Cost of dredging 25,084 cubic yards, at 40 cents.....	10,033.60
Cost of 840 cubic yards of riprap for Dike C.....	1,050.00
Cost of dredging channel to Acken's Wharf, 4,123 cubic yards, at 15 cents.....	618.45
Cost of operating supplies and repairs to steamer <i>Star</i>	891.78
Cost of examination and surveys.....	426.08
Cost of draughting.....	131.50
Cost of inspection.....	1,186.47
Cost of administration.....	475.34
Total.....	35,858.22

The commerce of the Raritan River during the past year has differed little from that of 1887, which, after a careful canvass, was estimated at 1,675,355 tons, valued at \$28,119,173. The number of boats passing the lock at New Brunswick was 7,674 against 7,257 for 1887. The city of New Brunswick has a population of about 20,000 people, and is the terminus of the Delaware and Raritan Canal.

The amount that can be expended profitably as regards the efficient prosecution of the work during the fiscal year ending June 30, 1891, is

\$100,000, and, if appropriated, will be expended in carrying the improved channel farther up the river toward New Brunswick.

The estimated amount required for the completion of the improvement is \$1,572,412.05.

This work is in the collection district of Perth Amboy, N. J., which is the nearest port of entry; nearest light-house, Great Beds Light, in Raritan Bay; nearest fort, fort at Sandy Hook, N. J.

Amount of revenue collected at the port of Perth Amboy during the fiscal year ending June 30, 1889, \$59,632.83.

Original estimate.....	\$2,093,662.05
Amount appropriated.....	521,250.00
Amount expended.....	492,350.80

Money statement.

July 1, 1888, amount available.....	\$14,571.86
Amount appropriated by act of August 11, 1888.....	50,000.00

64,571.86

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888..... \$35,672.66

July 1, 1889, outstanding liabilities..... 1,185.61

36,858.27

July 1, 1889, balance available.....	27,713.59
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{ Amount (estimated) required for completion of existing project.....	1,572,412.05
{ Amount that can be profitably expended in fiscal year ending June 30, 1891.....	100,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of bids for constructing three dump-scows, capacity, 800 cubic yards each, opened at the U. S. Engineer Office, Army Building, New York City, N. Y., at 12 o'clock m. on March 5, 1889, under advertisement dated February 11, 1889.

No.	Name and address of bidder.	Name and address of sureties.	Price bid per scow.	Total amount of bid.
1	Timothy Desmond, Hoboken, N. J.....	Not given.....	\$10,000	\$30,000
2	Alonzo J. Beardsley, Stratford, Conn. {	John McNeil, Bridgeport, Conn..... {	*4,850	*14,550
		Minot A. Blakeman, Stratford, Conn. {		
3	James D. Leary, New York, N. Y..... {	Joseph Cumings, New York, N. Y..... {	5,490	16,470
		James M. Cumings, New York, N. Y..... {		
4	Trundy & Murphy, Brooklyn, N. Y..... {	James Du Bois, Brooklyn, N. Y..... {	5,700	17,100
		Henry E. Du Bois, Brooklyn, N. Y..... {		

* White oak substituted for yellow pine for corner posts, bumpers, bits, and fenders; white oak or chestnut for end timbers and stanchions. The first scow will be completed and delivered in New York Harbor within sixty days, and the other two within ninety days after signing the contract.

NOTE.—The works available for payments under the contract to be entered into are the Raritan, South, Shrewsbury, and Passaic rivers, New Jersey, and the aggregate balance of the appropriations for these works, after deducting outstanding liabilities and amounts covered by existing contracts, is \$24,375.86.

A contract was made March 21, 1889, with James D. Leary, the lowest responsible bidder, who complied with the terms of the specifications.

COMMERCIAL STATISTICS.

The following statement of traffic passing Raritan River to and from the Delaware and Raritan Canal during the year ending December 31, 1888, was kindly furnished by Mr. D. C. Chase, superintendent of the Pennsylvania Steam Towing Company.

Vessels.	East bound.			West bound.		
	No.	Average draught.	Average tonnage.	No.	Average draught.	Average tonnage.
Steam	811	<i>Feet.</i> 7	<i>Tons.</i> 105	818	<i>Feet.</i> 7	<i>Tons.</i> 10
Sail	109	7	168	18	5	3
Barges	4,576	7	154	1,162	6	15
Rafts	171	1	80	9	1½	25
Total	5,667			2,007		

Articles.	East bound.		West bound.	
	Quantity.	Estimated value.	Quantity.	Estimated value.
Lumber	<i>Gross tons.</i> 24,000	\$240,000	12,572	\$125,700
Coal	605,525	2,544,300	3,136	15,600
Iron and ores	7,856	197,500	59,170	965,000
Agricultural products	22,462	1,704,600	23,174	1,742,050
General merchandise and miscellaneous	161,790	9,420,300	137,577	5,317,900
Total	821,732	14,106,700	235,629	8,166,850

F 10.

IMPROVEMENT OF SOUTH RIVER, NEW JERSEY.

Before the improvement of this stream was undertaken by the United States the navigation of the lower 2½ miles of its course had been abandoned, and a canal dredged at private expense from a short distance below Washington to Sayreville, on the Raritan River, in 1880, when the present project for improving the river was adopted. The mouth of this canal, on account of its faulty location, had shoaled to a depth of 6.4 feet at mean low water, and the best depth in the canal, some distance above, had decreased to 3.3 feet. Above Washington a depth of 2.7 feet existed to Bissett's, 3½ miles, and 2.5 feet to Old Bridge, the head of navigation, 6¼ miles above the mouth of the canal at Sayreville. The range of the tide was 5.3 feet at Sayreville. The town of Washington and numerous brick-yards did a commerce on the river valued at \$1,249,000.

The present project, adopted in 1880, provides for closing the river below the head of the canal, correcting the direction of the mouth of the latter, and obtaining, by diking and dredging, a depth of 8 feet mean low water to Washington, 6 feet to Bissett's, and 4 feet to Old Bridge, straightening the channel at two points by cutting across the meadow. It is estimated to cost \$194,695.

The amount expended under this project to June 30, 1888, was \$60,738.40, with which the direction of the mouth of the canal had been changed, the dikes below Washington completed, and a small amount of dredging done on a shoal above Washington. No increase in the commerce of the river had been observed.

No active work has been done on this improvement during the past fiscal year.

During the latter part of 1888 this office was in receipt of numerous complaints relative to the bridge of the Raritan River Railroad Company across the South River, which resulted in a letter, of which the following is an abstract:

ENGINEER OFFICE,
New York, December 22, 1888.

GENERAL: In compliance with indorsements of the Chief of Engineers, August 15 and 29, on communications of Hon. John Kean and Hon. J. R. McPherson relative to the bridge constructed by the Raritan River Railroad Company across South River, New Jersey, I have the honor to report that, as far as we have been able to discover, no formal or special permission has ever been given to the railroad company for the erection of the bridge in question other than the general laws of the State governing the construction of bridges over navigable waters.

The draw in its present position is undoubtedly an obstruction to the sailing vessels, which carry on by far the major part of the commerce of the river.

It is proposed to move the draw protection 40 feet to the eastward, the opening to the east of the draw-support to be 40 feet clear width, and that on the west 28 feet. These are the present dimensions of the fair-ways, and by simply moving the entire structure 40 feet to the eastward, as proposed, the railroad company will be at the minimum possible expense, as the original truss can be used without modification. This arrangement, according to Mr. James Bissett, would be entirely satisfactory to the sailing masters on the river.

As additional information I have the honor to inclose herewith affidavits of several parties doing business on the South River, a letter from the president of the railroad company, relative to the bridge, also two blue prints showing the present condition of the draw, and a tracing giving on a reduced scale the existing condition and the proposed modification, the former in black and the latter in red.

Very respectfully, your obedient servant,

THOS. L. CASEY,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

The company was subsequently ordered to make the change proposed in the above letter, but no steps had been taken at the close of the fiscal year.

An examination of the river from the mouth to the railroad bridge just mentioned was completed June 30, 1889, and shows that its physical condition has apparently undergone but slight change during the year.

The expenditures during the fiscal year amount to \$2,759.75, as follows:

Cost of pro rata share of 1 dipper-dredge.....	\$1,086.00
Cost of pro rata share of 3 dump-scows	823.50
Cost of pro rata share of 1 tug-boat.....	260.00
Cost of drafting.....	206.00
Cost of administration	384.25

Total 2,759.75

The sum of \$30,000 can be expended profitably as regards the efficient prosecution of the work during the fiscal year ending June 30, 1891. It would be applied to giving the channel the full dimensions required by the project below Washington, and extending the improvement to the brick-yards above; this would add greatly to the shipping facilities of the stream and would stimulate its increasing commerce.

The estimated amount required for the completion of the improvement is \$128,695.

This work is in the collection district of Amboy. The nearest port of entry, Perth Amboy, N. J.; nearest light-house, Great Beds Light, in Raritan Bay, New Jersey; nearest fort, fort at Sandy Hook, New Jersey.

Amount of revenue collected at the port of Perth Amboy during the fiscal year ending June 30, 1889, \$59,632.83.

Original estimate	\$194, 695. 00
Amount appropriated	66, 000. 00
Amount expended	63, 468. 00

Money statement.

July 1, 1888, amount available	\$291. 60
Amount appropriated by act of August 11, 1888	5, 000. 00

5, 291. 60

July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$2, 759. 75
July 1, 1889, outstanding liabilities	277. 66

3, 037. 41

July 1, 1889, balance available	2, 254. 20
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{ Amount (estimated) required for completion of existing project	128, 695. 00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	30, 000. 00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

F. II.

IMPROVEMENTS OF SHREWSBURY RIVER, NEW JERSEY.

The project for this improvement was adopted in 1879, and contemplates the formation of a channel 6 feet deep at mean low water, and from 300 to 150 feet in width, from the mouth of the river to Red Bank, on the North Branch, 8 miles, and to Branchport, on the South Branch, 9 miles.

In its original condition the river was much obstructed by sand-bars, on which the best depths at mean low water were, at the mouth, 3.9 feet; below Highland's Bridge, 5.4 feet; at Lower Rocky Point, 3.6 feet; at Barley Point, 3.3 feet; at Chalmer's, 5 feet; at Oceanic, 5.5 feet; below Belleville, 3.1 feet; at Seabright, 4.2 feet; at Jumping Point, 2.6 feet; at Sedge Island, 2.8 feet. A survey, completed in April, 1887, shows the depth at these points to be 5.9 feet, 7.7 feet, 3.6 feet, 7.8 feet, 7.2 feet, 4.5 feet, 5.9 feet, 4.4 feet, respectively. No changes are known to have taken place since.

The estimated cost of the existing project is \$254,562, of which \$210,233.45 had been expended June 30, 1889.

A project recommending the construction of stone dikes C 3, C 4, and M was approved by the Chief of Engineers July 13, 1887. A map showing the proposed work will be found in the Annual Report of the Chief of Engineers for 1887, page 780. A contract was made August 20, with F. P. Eastman, the lowest bidder, to construct the dikes at 98 cents per cubic yard of stone; the work was to be completed by November 1, 1887. The facilities of the contractor for doing the work proved to be inadequate; the contract was extended to December 1, and again to May 15, 1888, when the contractor reported his inability to complete the work, having delivered 1,843 cubic yards of stone, which had been placed in dikes C 3 and C 4.

On May 17 the work was again advertised, and sealed proposals were opened May 26. The lowest bidder was A. J. Howell, with whom a contract was made June 7 to deliver 2,000 cubic yards of stone, at \$1.45 per cubic yard. The contractor began the delivery of the stone on June 2, and carried on the work steadily until the close of the fiscal year ending June 30, 1888, when all the stone, 2,011 cubic yards, had been received on the work, and all had been placed in the dikes with the exception of one load of 333 cubic yards. This last load was placed

in position during the first days of the present fiscal year, and the contract closed July 5, 1888.

Dike C 4, 1,260 feet long, had been built to the height of extreme low water, and 4 feet wide on top, except for a distance of 30 feet at its junction with Dike C, where it was only raised to 2 feet below mean low water to permit the passage of row-boats. It has cost thus far \$2,585.15, as follows:

739 cubic yards of stone, at 98 cents.....	\$724.22
1,120 cubic yards of stone, at \$1.45.....	1,624.00
Piles marking line of dike.....	127.59
Inspection.....	109.34
Total.....	2,585.15

The cost is therefore shown to be \$2.05 per linear foot, or \$1.96 deducting the cost of inspection, which is a favorable showing in comparison with the cost of Dikes C 1 and C 2, which was \$4.75 per linear foot.

In order to ascertain the effect of Dike C 4 upon the bottom of the river in immediate proximity thereto, a careful survey was made during April and May, 1889. The result of this examination, when compared with hydrographical features existing before the dike was built, show that it has exerted no material influence in modifying the channels, but as the past winter has been a very mild and open one the action of floating ice is still practically undetermined.

The project of July 13, 1887, recommended among other modifications the abandonment of the Southern Channel in the vicinity of Oceanic, and the adoption of the Northern Channel, which was to be connected with the main channel below Upper Rocky Point by an oblique transverse cut. On the arrival of the United States dredging plant in the river, May 15, 1889, work was begun as soon as practicable on this cross-over channel, and has been steadily in progress until the close of the fiscal year. The amount of material removed was 11,945 cubic yards. This dredged material was dumped in the abandoned southern channel, which is no longer used by the steamers and other shipping.

The resulting channel has a width of 100 feet, and, although dredged to a depth of 7 feet, appears to be gradually filling with drifting sand. The construction of Dike M may ultimately prove a necessity, unless some better means can be devised to maintain the channel in this portion of the river, a problem by far the most difficult connected with the improvement.

As the performance of the new dredging plant to the close of the fiscal year may prove of general interest, it is given below in tabular form:*

Months.	Number of working days.	Time worked.	Time lost.	Total cubic yards dredged and dumped.	Number of cubic yards dredged per hour worked.	Actual cost per cubic yard of dredging and dumping.			Total cost per cubic yard including interest on plant.
						Dredging.	Dumping.	Total.	
1889.		Hours.	Hours.			Cents.	Cents.	Cents.	Cents.
May.....	11	85	25	3,750	44	7	4.4	11.4	12.9
June.....	25	195½	54½	8,195	42	8.6	6.7	15.2	17
Totals and averages...	36	280½	79½	11,945	42.58	8	6	14	15.7

* For description of dredge and other plant see report on the Raritan River.

NOTES.

1. The dumping ground was about 1 mile from the dredge, the current attaining at some stages of the tide a velocity of between 3 and 4 knots per hour.

2. The following extract from one of the recent reports of Mr. E. L. Ingram, captain of the dredge and inspector, will serve to show that the dredging in the Shrewsbury River has been under quite unfavorable conditions aggravated in addition by the fact that, owing to the slight depth of material to be removed, the dipper can only be worked to about one-third of its capacity:

UNITED STATES DREDGE ALPHA,
Highlands, N. J., June 15, 1889.

SIR: * * * I beg to call your attention to the following points which I have not yet brought into prominence:

1. The *Alpha* is a very large dredge, and is designed for deep digging. The depth we are making here is out of all proportion to the size of the machine. The spuds, for instance, are necessarily hoisted so high as to be extremely top-heavy, giving them great wrenching power, while at the same time they can not be dropped far enough to take much hold in the sand, thus occupying extra time and care to keep the dredge truly on line. An unfortunate wrench on the 13th tore two teeth from the after spud spur-wheel, causing eight hours' delay to put them in again. The dipper handle likewise acquires the same wrenching power from being drawn in so far, continually cutting of the bolts which hold the friction plates in place. On the 14th it became necessary to replace the bolts, causing a delay of two hours. I think I can prevent this trouble by bolting the timbers more thoroughly together in the neighborhood of the friction plates. Of course this would not be at all necessary where the work was proportioned to the machine.

2. In view of the above facts the machine requires great care in handling in order to avoid serious injury, and can not with safety be run at a high rate of speed. The machine is not doing the amount of work I would like to see her do, but if she is forced any more the delay by break-downs would more than balance any gain thereby. As one of the points which occupies time not usually needed in dredging, I may mention the hauling in of the dipper handle with the backing chain, which frequently has to be done two or three times over before it gets back to the unusual point desired.

3. The instructions were to dig not under 6 nor over 7 feet at mean low water, with as near an approach as possible to 7 feet. As far as possible this is done, but on low-water work the dipper can not always be got in far enough for this, so that the amount dredged exceeds what would be expected from my calculation based on the chart.

4. The cuts already finished have commenced filling in with loose sand. Cut No. 1 was dredged 7 feet and over at mean low water, and now has a depth ranging only from 6 to 6½ feet. The change in Cut 2 is not yet very decided.

Very respectfully, your obedient servant,

E. L. INGRAM,
Inspector.

Capt. THOS. L. CASEY.

3. The working day, as above considered, consists of 10 hours.

4. The interest on plant is computed at 4 per cent.

The condition of the river as a whole is practically the same as last year. A depth of 5.9 feet exists on the bar at the mouth of the river at mean low water, and 5.5 feet can be carried to Red Bank, and 4.5 feet to Branchport.

The expenditures during the fiscal year amount to \$10,104.87, as follows:

Construction of stone dikes (contract of June 7, 1888).....	\$2,915.95
Cost of pro rata share of 1 dipper dredge	2,172.00
Cost of pro rata share of 3 dump scows.....	1,647.00
Cost of pro rata share of 1 tug-boat	520.00
Cost of operating U. S. dredging plant (wages and supplies)	1,230.90
Cost of examination of river (1889).....	360.49
Cost of draughting.....	206.00
Cost of inspection.....	358.60
Cost of administration.....	693.93
Total.....	10,104.87

Whatever appropriation may be made by the next Congress will be expended in completing the dikes and dredging the shoals. The most economical results in the prosecution of the work can be obtained if the full amount required to complete the project be appropriated at once.

In addition to the steamers which regularly use the river a large number of small sailing vessels are engaged in the shipment of coal, lumber, sand, fish, and oysters.

Capt. Jas. S. Throckmorton of Red Bank, who has reported the commerce on the Shrewsbury River in past years, states that the aggregate for the year 1888 would amount to about the same as in 1887.

A record of the craft passing the Highlands draw-bridge, recorded during July, August, and September 1888, is as follows :

Steam-boats.....	545	Sloops	1,645
Propellers.....	660	Small craft.....	2,213
Tugs.....	13	Yachts.....	697
Canal-boats.....	2		
Schooners.....	437	Total	6,203

Probably 20,000 craft pass this draw annually.

This river is in the collection district of Perth Amboy, which is the nearest port of entry; nearest light-house, Navesink Light; and the nearest fort, at Sandy Hook, N. J.

Amount of revenue collected at the port of Perth Amboy during the fiscal year ending June 30, 1889, \$59,632.83.

Original estimate (revised 1887).....	\$254,562.00
Amount appropriated	214,500.00
Amount expended.....	210,233.45

Money statement.

July 1, 1888, amount available.....	\$1,354.12
Amount appropriated by act of August 11, 1888.....	10,000.00
	11,354.12
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$7,087.57
July 1, 1889, outstanding liabilities	998.72
	8,086.29
July 1, 1889, balance available.....	3,267.83
{ Amount (estimated) required for completion of existing project.....	40,062.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	40,062.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

F 12.

IMPROVEMENT OF KEYPORT HARBOR, NEW JERSEY.

Keyport Harbor was originally accessible at low water only to vessels drawing less than 4 feet. Before its improvement was undertaken by the United States, a 6-foot channel had been dredged at private expense, which had shoaled in 1872 to 5½ feet, and in 1882 to 5 feet, the range of the tide being 4.7 feet. A large commerce was carried on, however, valued at \$2,932,000.

The project for the improvement was adopted in 1873, and provided for dredging a channel 4,700 feet long, 8 feet deep at mean low water,

and 200 feet wide from the steam-boat dock to the 8-foot contour in Raritan Bay, at an estimated cost of \$30,475.

The amount expended under this project to June 30, 1888, was \$30,042.89, with which a channel had been dredged from the 8-foot curve in Raritan Bay to Keyport Wharf, a distance of 5,000 feet, with a width of 200 feet for the first 4,200 feet, and 160 feet for the remainder.

The commerce of the harbor had increased greatly, being estimated at \$5,000,000, besides 150,000 passengers carried annually.

There has been no appropriation for this work since 1882, and the expenditures for the last fiscal year amounted to \$290.83 for office expenses.

The dredged channel is stated to have shoaled in places to about 6 feet mean low water, but it is reported that the commerce as yet shows no falling off.

If it is the intention of Congress to complete this improvement, the balance of the estimate, \$10,000, can be expended profitably as regards the efficient prosecution of the work during the fiscal year ending June 30, 1891, and would be applied to dredging the channel to the dimensions required by the project, which would add materially to existing facilities.

The estimated amount required for the completion of the improvement is \$10,000.

This work is in the collection district of Perth Amboy, N. J., which is the nearest port of entry. Nearest light-house, Great Beds Light, in Raritan Bay; nearest fort, fort at Sandy Hook, N. J.

Amount of revenue collected at the port of Perth Amboy during the fiscal year ending June 30, 1889, \$59,632.83.

Original estimate (1873)	\$30,475.00
Revised estimate (1884)	40,475.00
Amount appropriated	30,475.00
Amount expended	30,333.72

Money statement.

July 1, 1888, amount available	\$427.11
July 1, 1889, amount expended during fiscal year, exclusive of liabilities outstanding July 1, 1888	\$285.83
July 1, 1889, outstanding liabilities	69.60
	<hr/> 355.43
July 1, 1889, balance available	<hr/> 71.68
{ Amount (estimated) required for completion of existing project	10,000.00
{ Amount that can be profitably expended in fiscal year ending June 30, 1891	10,000.00
{ Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

F 13.

PRELIMINARY EXAMINATION OF EAST ROCKAWAY CREEK, LONG ISLAND, NEW YORK.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., October 25, 1888.

GENERAL: In compliance with Department letter of September 29, 1888, I have the honor to submit the following report on the preliminary examination of East Rockaway Creek, Long Island, N. Y.

The act of August 11, 1888, provides for surveys of East Rockaway Creek, Long Island, and of East Rockaway Creek, and both items were referred to me for report by Department letter of August 28, 1888. As

far as I am aware there is but one East Rockaway Creek in this neighborhood, and it is believed that the item is repeated in the bill unintentionally.

East Rockaway Creek, Long Island, N. Y., is a small stream that flows into Hempstead Bay on the south side of Long Island. The villages of East Rockaway, Pearsalls, and Rockville Centre are situated on or near its banks, and contain a population of from 2,000 to 3,000 inhabitants.

The only shipments from the locality are oysters and garden truck, both of which go mainly by rail to New York, and would, I think, be likely to continue to do so were the stream improved as desired.

The receipts consist of the coal and building materials required for this small community, whose main industries are farming, fishing, and a small amount of summer resort business; they do not exceed 10,000 tons annually.

East Rockaway Creek formerly discharged a considerable volume of fresh water, and was then navigable for schooners of 40 tons from the Bay to the village, about 3 miles.

But the stream has been dammed a short distance above East Rockaway and the fresh water diverted as a water supply to Brooklyn, causing the creek to shoal so that its depth is now in places only 1 foot at low tide. The range of the tide is about $4\frac{1}{2}$ feet.

The improvement desired consists in straightening the creek at the sharp bends and dredging a channel 60 feet wide and 4 feet deep at mean low water from Hempstead Bay to East Rockaway. As far as I am able to judge, in the absence of a detailed survey, such an improvement would probably cost about \$25,000; on account of the light draught of the channel, the small amount of work to be done, and the difficulty of reaching the locality, dredging would be expensive. As the creek has shoaled once it would undoubtedly shoal again; and in the course of time would have to be dredged again.

Finally, by comparing this creek with Sumpawams Inlet, Rahway River, and Woodbridge Creek, where improvements were first begun and then abandoned by Congress, I am forced to the conclusion that East Rockaway Creek is not now worthy of improvement, for the possibilities of the creek itself are less than those of the streams mentioned and the population and interests that would be benefited are also less.

Very respectfully, your obedient servant,

GEORGE McC. DERBY,

Captain of Engineers, in temporary charge.

The CHIEF OF ENGINEERS, U. S. A.

F 14.

PRELIMINARY EXAMINATION OF HACKENSACK RIVER, NEW JERSEY,
FROM THE LOWER BRIDGE AT THE TOWN OF HACKENSACK TO THE
ERIE RAILWAY BRIDGE.

UNITED STATES ENGINEER OFFICE,
New York, October 24, 1888.

GENERAL: In compliance with Department letter of September 29, I have the honor to submit the following report on the preliminary examination of Hackensack River from the lower bridge at the town of Hackensack to the Erie Railway Bridge.

The Hackensack River is a stream of considerable size entering New ark Bay at the head of the bay ; it is navigable for a distance of about 16 miles.

Below the Erie Railroad Bridge the channel has ample width and depth, and the same may be said of the next 5 miles of its course to Little Ferry, there being a depth of 9.5 feet at low water with a width of about 300 feet. The range of the tide is about 4.5 feet.

From Little Ferry to Hackensack, about $2\frac{1}{2}$ miles, the stream is in places narrow and obstructed by sand bars, on which the low-water depth is about 5 feet.

The improvement desired consists in widening the channel on this reach of the river to 200 feet and deepening it to 8 feet at mean low water.

As far as I am able to judge, in the absence of a complete survey, I am of the opinion that this improvement could be made for about \$25,000. It would meet the present demands of commerce and the prospective demands for many years to come.

The lower 12 miles of the course of the Hackensack River, runs through salt meadows as yet entirely unimproved, but destined within the next twenty years to become very valuable ; above Little Ferry, however, the country is well settled, the population of the four townships adjoining the river being about 18,000 people.

The principal industry of the locality is brick-making, estimated at 85,000,000 brick per annum, and said to be on the increase. There are also a number of other factories established on the stream. The river also carries the coal for the brick-yards, factories, and towns on its banks, and manure for the neighboring farms. The farming produce, however, goes by rail or is hauled in wagons to New York, there being no regular steam-boat line on the river at present.

In my opinion the Hackensack River is worthy of improvement ; it is a valuable stream naturally and susceptible of being made much more so at moderate expense.

The population and interests that would be benefited by its improvement are large and growing, and the saving in the cost of transportation would more than pay the interest on the probable cost of the work.

No survey will be required between the Erie Railway Bridge and Little Ferry, and I estimate the cost of surveying the reach requiring improvement at \$1,000.

Very respectfully, your obedient servant,

GEO. MCC. DERBY,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

SURVEY OF HACKENSACK RIVER, NEW JERSEY, FROM THE LOWER BRIDGE AT THE TOWN OF HACKENSACK TO THE ERIE RAILWAY BRIDGE.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., June 30, 1889.

GENERAL: I have the honor to submit the following report, with accompanying map, upon the survey of the Hackensack River, New Jersey, "from the lower bridge in the town of Hackensack to the Erie Railway Bridge," authorized by act of Congress approved August 11, 1888, and made May 8-24, in accordance with Department instructions dated April 1, 1889.

The Hackensack is a tidal stream of very gentle slope, flowing for the most part through a low-lying and swampy region in a course very nearly parallel to the Passaic and about midway between the latter and the Hudson. From Little Ferry, where it receives on the left a broad sluggish tidal stream called Overpeck Creek, to its mouth in Newark Bay its widths are far in excess of the corresponding ones of the Passaic and its facilities for navigation under sail much greater. The navigation of both streams is, however, greatly impeded by the very numerous railroad bridges crossing their lower reaches.

A preliminary report, concerning the advisability of the improvement of this water-way, was made by Capt. George McC. Derby, Corps of Engineers, October 24, 1888, to which attention is invited, and in which it is stated that the river is susceptible of improvement at a moderate cost, and that the improvement is well warranted by the present and prospective demands of commerce.

The present detailed survey entirely confirms the views of Captain Derby as to the relatively slight cost of the improvement, and the accompanying report of Mr. C. S. Kelsey shows that the commercial interests at present existing virtually demand it.

There are nine extensive brick-yards located on the river, and in addition five factories, six public wharves, ten or twelve docks for the discharge of coal, and two lumber yards. At the town of Hackensack there are some 1,500 linear feet of wharfage already built. The annual traffic amounts to 250,000 tons, valued at \$1,000,000.

Navigation is impeded by a bar opposite Benny's Mill having a minimum channel depth of 4.8 feet. Opposite Ridgely Park and from Bogota to Hackensack the 8-foot channel narrows, ranging from 35 to 100 feet in width.

As stated in the preliminary report of October 24, 1888, no survey or improvement of the section from the Erie Railroad Bridge to Little Ferry is required, and no survey of this section was made, the allotment of \$500 being only sufficient to complete the survey of the remaining and more obstructed portion.

In this preliminary report a channel 200 feet wide and 8 feet deep at mean low water is suggested, but as petitioners have since asked for a greater channel depth than 8 feet, and advocate a 10-foot channel to meet the demands of commerce, and as the increased cost of such a channel is relatively slight, I would recommend the improvement of the river by dredging a channel 10 feet in depth at mean low water, 200 feet wide from Little Ferry to Gasworks Creek, and 150 feet wide thence to the lower bridge, at the town of Hackensack, as indicated on the map.

For the present no training-dikes are recommended. After the improvement is completed, and only until a time subsequent to such completion, can useful data be obtained upon which to base the location of these dikes, at least as part of a consistent and complete scheme of improvement.

The material to be dredged is supposed to consist of mud, clay, and sand, although, because of insufficient funds, no borings were taken. The estimated cost is \$60,000, and if the project be approved \$60,000 could, if appropriated, be advantageously expended during the fiscal year ending June 30, 1891.

The accompanying report of Mr. C. S. Kelsey, surveyor, who conducted the survey, gives the more important details of its extent and the methods employed, together with facts relating to the commercial importance of the stream and estimates of the cost of its improvement.

The nearest port of entry is Newark, N. J. The amount of revenue collected at Newark during the year ending June 30, 1889, was \$2,018.07.

Very respectfully, your obedient servant,

THOS. L. CASEY,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. C. S. KELSEY, SURVEYOR.

NEW YORK, N. Y., June 21, 1889.

CAPTAIN: I have the honor to submit the following report, with accompanying maps, on the preliminary survey of the Hackensack River from Little Ferry to the Turnpike Bridge at Hackensack:

As stated in my report of the preliminary examination of the Hackensack River from the Erie Railroad Bridge to the town of Hackensack, submitted October 13, 1888, there is a channel of abundant width and of a greater depth than on the bar in Newark Bay as far up the Hackensack River as Little Ferry, and no survey of this portion of the river was ordered.

The survey was made during May 8-24, 1889. As no determination of the plane of mean low water at this section of the river could be obtained from the United States Coast Survey, tidal observations were necessary and were taken during a complete lunitation at the Hackensack Dock. A base-line over 1,400 feet long was measured with exactness at the lower limits of the survey and a triangulation carried up to a check-base at the further limits.

The topography was shown from the high-water line back to the New York, Susquehanna and Western Railroad on the east shore and back to the turnpike from Hackensack to Little Ferry on the west side.

The soundings are located instrumentally, are expressed in feet, and refer to the plane of mean low water determined at the Hackensack Dock.

The river maintains the character of a tidal basin even as far up as Hackensack; the tidal observations showing a mean rise and fall of 5.2 feet at Hackensack against 4.6 feet at the mouth of the river, 13 miles below, as determined by the United States Engineer in 1879.

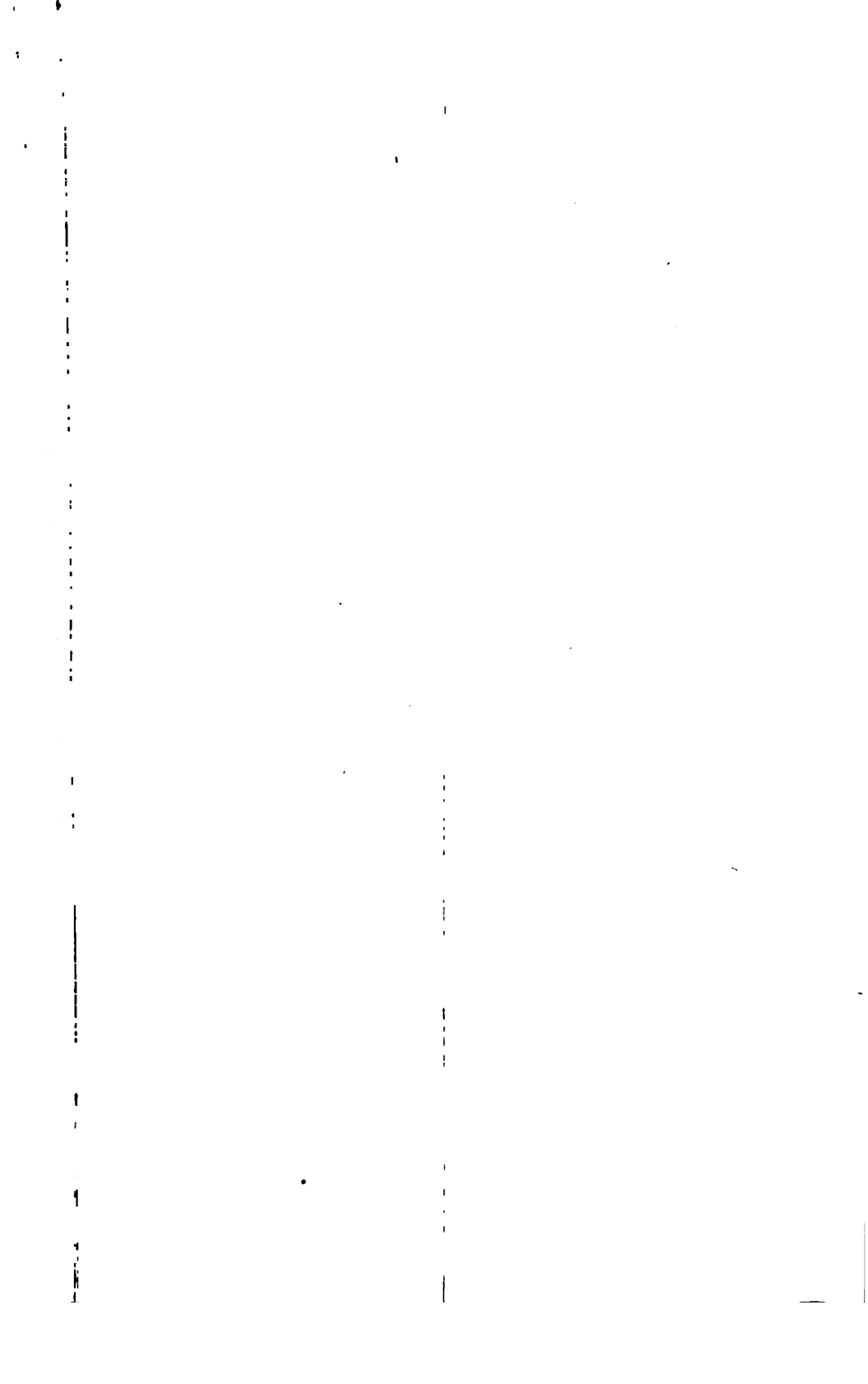
The lower reaches of the river run through an extensive salt marsh, but from Little Ferry the upland extends down to the banks of the river or in close proximity.

Along the section under survey there is an active commerce carried on, estimated at about 250,000 tons annually, valued at \$1,000,000, depending on the brick-yards and factories along the banks, coal and lumber docks, and public wharves, and contributing to a population of 6,000 people in the town of Hackensack, or about 18,000 in the townships bordering this portion of the river.

An exact and detailed statement of the commerce for the past year, made up from the written statements of the individual firms, is as follows:

	Tons.	Value.
IMPORTS.		
Coal and coal-dust.....	27, 030	\$114, 815
Wood.....	29, 400	83, 200
Lumber.....	7, 490	139, 500
Brick, sand, stone, etc.....	1, 728	4, 230
Manure and fertilizer.....	5, 000	10, 000
Total.....	70, 540	356, 745
EXPORTS.		
Brick (88,000,000).....	176, 000	608, 000
Total commerce.....	246, 540	964, 745

The essential requirements of the commerce are a channel that will allow of the numerous lumber schooners drawing from 11 to 12 feet, proceeding direct to Hackensack at all conditions of high water; and also a beating-channel for sailing vessels with a draught up to 8.5 feet, as far as the upper brick-yards. The petitioners ask for a channel to Hackensack, 200 feet wide and 10 feet deep at mean low water.





The survey shows but one bar across the channel, Benny's Bar, having a minimum depth in channel of 4.8 feet. At Ridgefield Park the 8-foot channel narrows to 100 feet, and above the bend at Bogota the channel is but 35 feet in width.

Between the wharves at Hackensack there is need of a turning-basin.

Owing to the small amount of funds available no borings were taken, but the indications are that Benny's Bar is a clay formation that has resisted the eroding powers, but not of a consistency to make removal difficult. No works would seem necessary to maintain the permanency of a channel through the bar. The narrowing of the channel at Ridgefield Park is caused by a deposit of mud and sand due to the sudden enlargement of the cross-section at this point, and contracting works may be required to maintain a widened channel; to maintain also a channel above Bogota will require deflecting works to prevent the wasting of the flood-tide up the blind channel on the north shore.

Below are submitted estimates for a permanent improvement, and a modified improvement.

ESTIMATES FOR PERMANENT IMPROVEMENT.

For providing and maintaining a channel 10 feet deep at mean low water, 200 feet wide to Gas-works, thence 150 feet wide to the Turnpike Bridge at Hackensack.

(a) Ridgefield Park to Benny's Bar:	
Dredging and rehandling mud and sand, 21,314 cubic yards, at 25 cents	\$5,328.50
Constructing 1,200 feet earthen dike A:	
Two thousand cubic yards of paving stone, at \$1.25	\$2,500
Dredging not indicated in above rehandling	500
	<hr/> 3,000.00
(b) Benny's Bar: Dredging and rehandling clay, mud, and sand, 87,910 cubic yards, at 30 cents	26,373.00
(c) Benny's Bar to Turnpike Bridge, Hackensack:	
Dredging and rehandling mud and sand, 59,790 cubic yards, at 25 cents	14,947.50
Constructing 400 feet earthen and riprap dike B:	
Three thousand eight hundred cubic yards paving stone, at \$1.25	\$4,750
Dredging not included in above rehandling	250
	<hr/> 5,000.00
	<hr/> 54,649.00
Ten per cent. for engineering and contingencies	5,464.90
	<hr/>
Total cost	60,113.90

ESTIMATE FOR MODIFIED IMPROVEMENT.

For dredging a channel 8 feet deep at mean low water and 200 feet wide to Gas-works Creek, thence 150 feet wide to the Turnpike Bridge at Hackensack.

(a) Ridgefield Park to Benny's Bar: Dredging and rehandling mud and sand, 6,420 cubic yards, at 25 cents	
	\$1,605.00
(b) Benny's Bar: Dredging and handling mud, clay, and sand, 38,086 cubic yards, at 30 cents	
	11,425.80
(c) Benny's Bar to Turnpike Bridge: Dredging and rehandling mud and sand, 29,000 cubic yards, at 25 cents	
	7,250.00
	<hr/> 20,280.80
Ten per cent. for engineering and contingencies	2,028.08
	<hr/>
Total cost	22,308.88

Allowance is made in each estimate for five-tenths of a foot over depth in dredging, and 30 per cent. increase in scow measurement over place measurement.

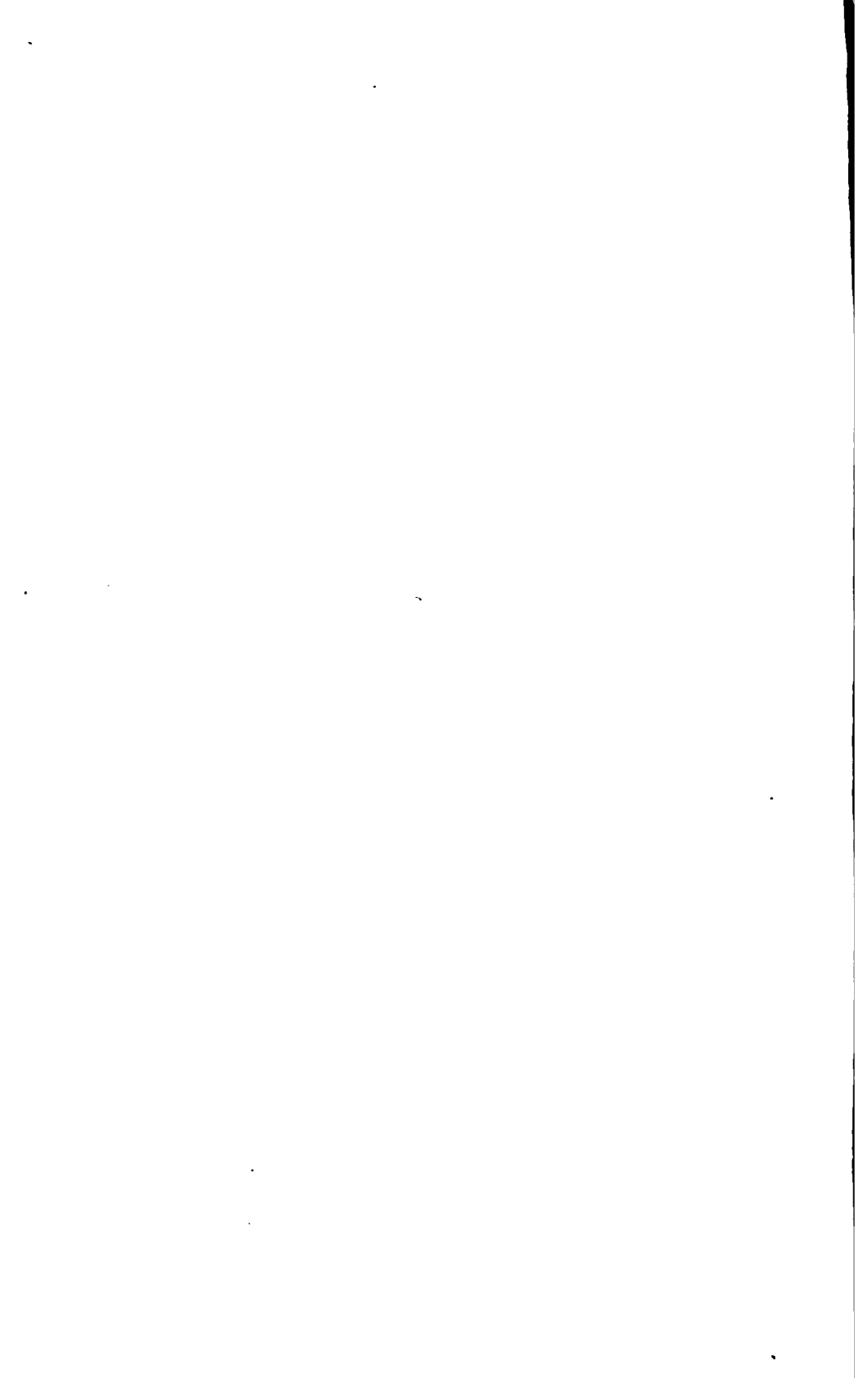
Your attention is, furthermore, called to the position of the draw in the bridge at Little Ferry. Being placed close against the west bank, sailing vessels experience difficulty in beating through.

By moving the draw opening 60 feet towards the east shore and widening the span to 50 feet in, the full benefit of the channel could be utilized.

Respectfully submitted.

C. S. KELSEY,
Surveyor.

Capt. THOS. L. CASEY,
Corps of Engineers, U. S. A.



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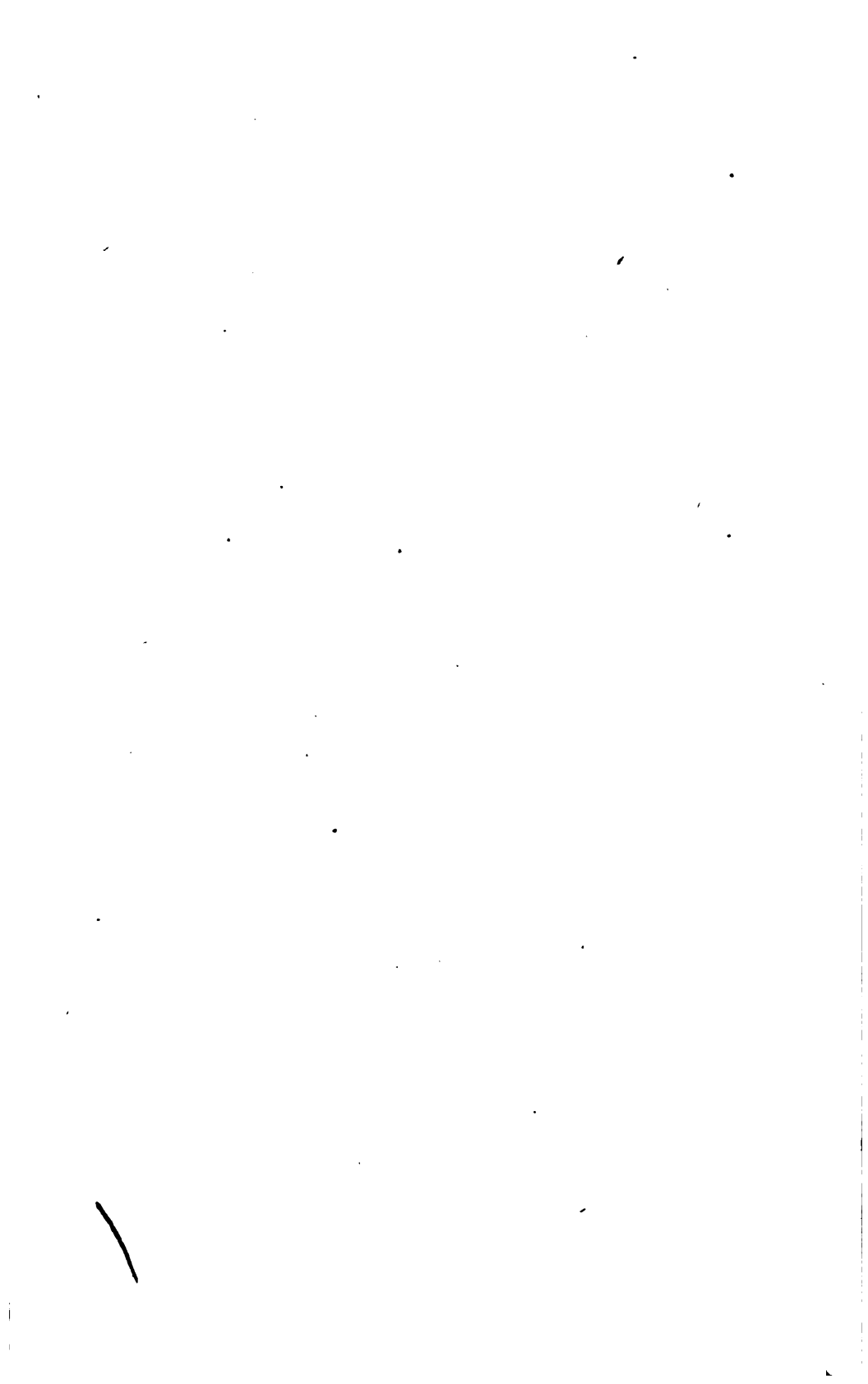
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